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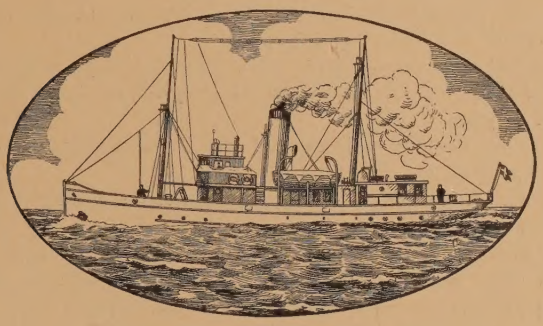
of

The Danish Biological Station

to

The Ministry of Agriculture and Fisheries



XLIII.

1938.

By

H. Blegvad, Ph. D.
Director

Copenhagen. C. A Reitzel.
1939.

The Reports from the Danish Biological Station (Nos. I—XXI) are published in the official Danish "Fiskeri-Beretning" for the years 1890—91 until 1912. After this year they appear as special publications. The Reports I—XXXII are edited by the late Dr. C. G. Joh. Petersen, the Reports XXXIII—XXXVI by Dr. A. C. Johansen and the later Reports by Dr. H. Blegvad.

I. *C. G. Joh. Petersen:* Fiskenes biologiske Forhold i Holbæk Fjord. (1890—91)*) 63 pp. 1 Chart. Out of print.

II. *Idem:* On the Eggs and Breeding of our Gobiidæ. (1891—92.) 9 pp. Two Plates. Out of print.

III. *Idem:* The Pelagic Life in Fænø Sound etc. (1892—93.) 38 pp. Tables. Out of print.

IV. *Idem:* On the Biology of our Flat-fishes and on the decrease of our Flat-fish Fisheries. (1893—94.) 146 pp. 2 Plates. 1 Chart. Many Tables. Out of print.

V. *Idem:* The common Eel (*Anguilla vulgaris* T.) gets a Particular Breeding-dress before its Emigration to the Sea. (1894—95.) 35 pp. With 2 Plates.
Etc. 64 pp. Out of print.

VI. *Idem:* The Yearly Immigration of young Plaice into the Limfjord etc. (1895—96). 48 pp. 1 Chart. 2 Tables. Out of print.

VII. *Idem:* Plankton-Studies in the Limfjord. 1897. 23 pp. 1 Map. 4 Tables. Out of print.

VIII. *Idem:* An Otter-Seine for the Exploration of Deeper-Seas. 1898. 24 pp. With 10 Figures. Out of print.

IX. *Idem:* Trawlings in the Skager Rack and the Northern Cattegat in 1897 and 98. 1899. 56 pp. With one Map. Out of print.

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XI. *Idem:* I. The Biology of the Cod in the Danish Seas. II. On other Codfishes in our Seas. III. Some General Observations on Protection, Legislation etc. IV. Alterations and Improvements on Otter-seines for Zoological Purposes. 1900 and 1901. 44 pp.

XII. *Idem:* I. Where, and under what Conditions, can the Eggs of Plaice be developed into Young Fish within the Skaw? II. On the Young Stages of the genus *Zeugopterus.* (With one Plate). III. Can we enter into Competition with the Foreign Steam-trawlers in our Seas outside the Danish Territorial Limit. 1902 and 1903. 33 pp.

XIII. *A. Otterstrøm:* Eggs and Young of Fishes in the Danish Waters. (Investigations during 1904 and earlier years.) 1903 and 1904. 85 pp.

XIV. I. *C. G. Joh. Petersen:* The Influence of Light on the Migrations of the Eel. II. *K. I. Gemzøe:* Age and Rate of Growth of the Eel. 1906. 39 pp.

XV. *Idem:* I. First Report on the Oysters and Oyster Fisheries in the Lim Fjord. (70 pp.) 1908.

XVI. *C. H. Ostenfeld:* On the Ecology and Distribution of the Grass Wrack (*Zostera marina*) in Danish Waters. With 9 figures. 1908. 62 pp.

XVII. *C. G. Joh. Petersen:* II. Second Report on the Oyster and Oyster Fisheries in the Lim Fjord. 1908. (24 pp).

XVIII. *C. G. Joh. Petersen:* I. The Yield of the Limfjord fisheries in recent years and the transplantation of Plaice in 1908. With 6 tables and 1 Chart. II. Biological investigations on the stock of Plaice in the Limfjord. With 3 Tables. III. The Yield of the Prawn fishery from 1885—1907 and its improvement by means of protection. With 3 Tables. 25 pp. 1909.

XIX. *Idem:* Some Experiments on the Possibility of combating the harmful Animals of the Fisheries, especially the Whelks in the Limfjord. 20 pp. 1911.

XX. *C. G. Joh. Petersen* og *P. Boysen Jensen:* Valuation of the Sea. I. Animal Life of the Sea-Bottom, its food and quantity. With 6 Tables, 3 Charts and 6 Plates. 81 pp. 1911.

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*) The figures in ( ) refer to the "Fiskeri-Beretning" for the years quoted.

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On the Migrations and the Racial Character of the Plaice.

By

ERIK M. POULSEN

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Introduction.

The stock of plaice in the marine area from the North Sea through the inner Danish waters to the southern Baltic is generally considered to consist of two races, which are termed the North Sea Race and the Baltic Race (A. C. Johansen, 1910 and 1928, Erik M. Poulsen, 1932) or the Atlantic Form and the Baltic Form (R. Kändler, 1935). The home, that is to say the spawning places, of the North Sea race are the North Sea, the Skagerak and the Northern Kattegat while the Baltic race spawns in the Southern Kattegat, the Belt Sea and the Baltic.

However, the variations in the number of anal fin rays from one locality to another within the distributional areas of the two races make one think that the two races cannot be juxtaposed because the Baltic race does not constitute a unity in the same sense as the North Sea race. Within the area of the Baltic race there is a much greater variation in the number of fin rays from place to place and from one year-class to another than is the case in the distributional area of the North Sea race. For the same year-class in different places of the North Sea and the Skagerak (see Summary 1) we find the following numbers of anal fin rays (No. of ind. in brackets)[1]).

Accordingly, the variations from one area to another is in no case higher than 0.4 ray for the same year-class.

Summary 1.

Year-class	1905	1928	1929	1932	1934
Scotland (St. Andrew's B.)	..	..	..	54.59 (225)*	..
The Channel (Plymouth)	..	..	..	54.71 (99)*	..
The B. of Heligoland	..	53.42 (382)*	53.53 (204)*	55.00 (206)*	..
The Horns Reef	..	53.81 (404)	53.92 (208)	54.82 (576)	54.18 (773)
Off Thyborøn	54.34 (153)	..	..	54.70 (326)	54.19 (683)
The Skagerak	54.30 (173)	53.85 (270)	..	..	..
Difference	0.04	0.43	0.39	0.41	0.01

Summary 2.

Year-class	1927	1928	1930	1934
The Western Baltic	51.07 (160)*	..	49.96 (248)*	..
E. of Møen and Falster	49.23 (73)	..	..	50.10 (64)
The Arkona Basin	..	..	51.86 (242)*	..
E. of Rügen	..	52.16 (286)	51.67 (199)	51.77 (551)
The western coast of Bornholm	..	..	..	51.19 (216)
The southern and eastern coast of Bornholm	..	50.21 (95)	..	50.90 (239)
The Bornholm Basin, etc.	51.53 (225)*	52.25 (256)*	..	52.38 (706)*
Difference	2.30	2.04	1.90	2.28

On the other hand some analyses from the Baltic will show that within a limited area we here find a much greater variation between the individual localities (see Summary 2).

In other words the variation of the same year-class from one locality of the Baltic to another is about 2 rays against only 0.4 in the North Sea. In the southern Baltic the number of rays is about

[1]) The analyses marked * are taken from R. Kändler, Rassenkundliche Untersuchungen an Plattfische. Ber. d. deutschen wiss. Komm. f. Meeresforsch. N. F. VIII, 4, 1935.

52, and so there is just as great difference between the western and the southern Baltic as between the latter and the North Sea. The great variation of the number of rays within the Baltic (and the Belt Sea) in comparison with the inconsiderable variation of the North Sea and the Skagerak makes it clear that the plaice population of the Baltic area does not constitute a unity in the same sense as the of the North Sea and the Skagerak, but is rather a complex of several local races often more or less inter mixed with each other and, in the northern part of the area, also with plaice of the North Sea race. So the concept of a "Baltic race" can hardly be maintained as a racial terminology for the stock of plaice that populates the southern Kattegat, the Belt Sea and the Baltic.

The fact that a race showing a fixed character throughout large areas of the North Sea is divided into several races in the inner Danish waters and the Baltic is well-known from another fish that has been thoroughly examined in a racial respect, i. e. the herring, of which the North Sea lodges one autumn spawning race, the bank herring, nearly throughout the whole of its area whereas the waters inside the Skaw contain several local races of autumn spawning herrings of comparatively confined distribution.

In the following it is intended to give an account of the changes of the numerical racial characters from place to place and from year-class to year-class in the different Danish waters, to throw a light on the relations between the North Sea race and the Baltic race, to determine the extent of the intermixing of the races in the different areas, and to account for the importance that may be attached to the exchange of plaice from the different areas with a view to renewing the population of the waters in question. From the Danish investigations of the last decennium a very large material of countings of anal fin rays is in hand, and so it will be expedient to confine the investigations to this one character.

The material of the investigation has been collected by the Danish Biological Station and Kommissionen for Danmarks Fiskeri- og Havundersøgelser and chiefly originates from the years between 1928 and 1938. A limited part of the material has previously been published (A. C. Johansen, 1928, l. c. and older works, Erik M. Poulsen, 1932, l. c.).

Analyses of Spawning Fish.

When we use analyses of the number of anal fin rays for the purpose of establishing the extent of the regional changes in the plaice population of our waters, it is necessary first and foremost to procure a survey of the numbers of anal fin rays in stocks of spawning plaice from different waters because we may thus get an expression of the number of anal fin rays in the fry spawned in these areas. By spawning fish are hear meant fish that have just begun spawning (maturity V—VI), that is to say ♂♂ with sperm beginning to flow and ♀♀ with a few opaque eggs in the ovary), that are about spawning (maturity VI, ♂♂ with rapidly flowing sperm and ♀♀ in which most of the eggs are translucent), and finally fish that are nearly spent (maturity VI—VII or VII (♀♀ with a few opaque eggs and ♂♂ with a little flowing sperm left)). Fish of maturity IV and V and VIII were only included when the material of actual spawners was insignificant. The "spawning fish" have been confined within so narrow limits because there is reason to believe that the very fish that approach the stage of spawning (maturity IV and V) are inclined to migrate (see page 41) in consequence of their craving for the most suitable spawning places, so that we cannot be sure that plaice of maturity IV and V caught in some area would actually have spawned within this area.

The numbers of anal fin rays in spawning plaice from various parts of the Danish waters are stated in Table I (page 00). In Figure 1 are given the mean numbers of rays found in the different areas, together with the mean error (m) and the standard deviation (σ)[1]).

The North Sea.

From the North Sea we have one analysis from the area S. of the Horns Reef in September 1905. The analysis includes only 26 individuals, which are stated to be mature, that is to say that they have spawned during the past season or are going to spawn in the next. In this analysis the number of

[1]) The standard deviation (σ) was calculated from $\sigma = \sqrt{\frac{\Sigma p a^2}{n} - b^2}$ and the mean error (m) from $m = \frac{\sigma}{\sqrt{n}}$.

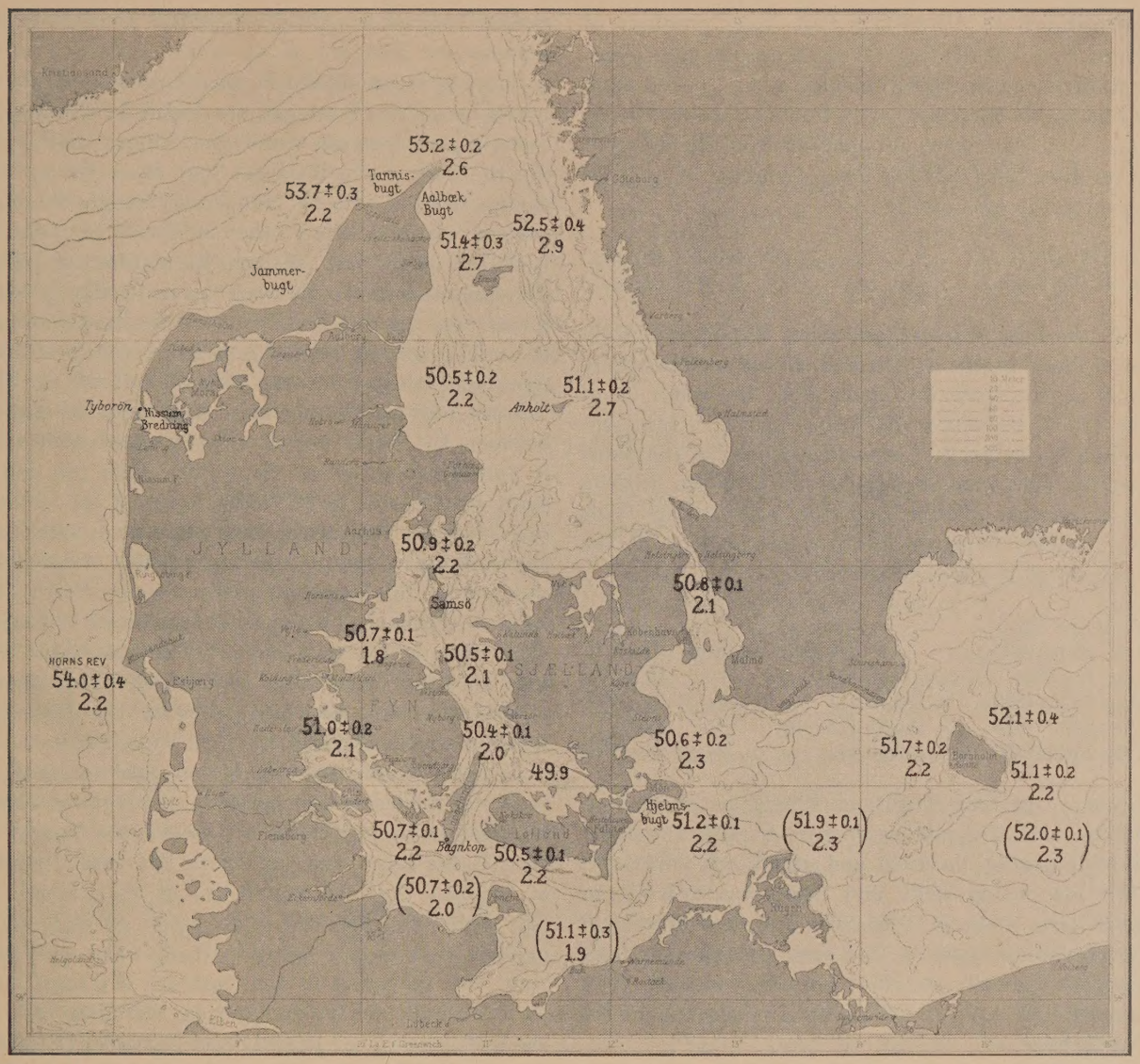

Fig. 1. Spawning plaice; mean numbers of anal fin rays together with mean error and standard deviation (cp. Table I).

rays is 54.04, which corresponds to the average number of anal fin rays in the young fish from the Horns Reef Area, viz. about 54.03.

The Skagerak.

In the Skagerak the principal spawning localities of the plaice are found between Hanstholm and NE. of the Skaw at depths of about 20—50 m. One of the most important and most intensely worked spawning places is situated N. and NW. of the Skaw close on the shore at a depth of about 40 m. An intense fishing for plaice, more particularly the spawning fish, is carried on here in winter. During the marking experiments with plaice transplanted from the North Sea to the Belt Sea it has turned out (H. Blegvad, 1935, Figure 30, page 30) that most of the plaice that had left the transplantation areas were recaptured in this very locality during the winter months. Also the few individuals from the marking experiments with local Belt Sea plaice that had covered longer distances from the transplantation areas were recaptured on or near this spawning place. Evidently, plaice from various waters, principally the northern Kattegat, go to the area N. of the Skaw for the purpose of spawning. It was demonstrated by A. C. Johansen, 1907 (see

for instance Pl. II & III) that large numbers of plaice from the Kattegat visit this spawning place.

Analyses of spawning fish are in hand partly from the water off Hirshals, partly from the said spawning place N. of the Skaw. All analyses from the different years give the following mean numbers of anal fin rays for the two areas:

Off Hirshals	53.68 ± 0.28	(56 ind.)
N. of the Skaw	53.17 ± 0.19	(196 ind.)

In the former area the number of rays is slightly lower than in the North Sea, but it is essentially lower in the spawning plaice from the water N. of the Skaw, the difference being nearly 1 ray. Apparently, the stock of spawning fish N. of the Skaw already shows some admixture of plaice with a lower number of rays from the inner waters. This fact appears more distinctly when we look at the analyses of the individual years:

N. of the Skaw,				
Feb. 13th, 1903	54.55	(29 ind.,	maturity	VI—VII)
— 1st—8th, 1910	52.56	(71 —	—	VI—VII)
Mar. 15th, 1922	53.55	(11 —	—	VII)
— 28th, 1928	53.29	(73 —	—	VI—VII)
Feb. 13th, 1936	52.50	(12 —	—	V-VI—VII)

The years 1903, 1910 and 1928 show an obvious difference in the number of rays. In 1903 the figure is high (54.55); in 1928 and still more in 1910 it it is low, being 53.29 and 52.56, respectively, or 1—2 lower than in 1903. The mixed character of the spawning stock of this area also appears from the fact that the standard deviation is high, 2.63, against only 2.17 and 2.19 off Hirshals and in the North Sea.

Apparently, plaice of the North Sea race pervade this locality in certain years while at other times the influx of Kattegat plaice is rather perceptible. However, the material is too small to lead to the causes of the changing intensity of the immigration from the Kattegat.

The Kattegat.

In the Kattegat the spawning localities of the plaice are dispersed over the greater part of the water; but the shallow western part between the eastern coast of Jutland and Læsø—Anholt is not very much frequented. The more important spawning areas are situated between the Skaw and Læsø, N. and E. of Læsø down towards Anholt and in the regions between Anholt—Schultz Grund—Lysegrunden.

The highest numbers of anal fin rays of plaice spawning in the Kattegat are found in the northeastern part between Læsø and Vinga, that is to say the part of the Kattegat that offers the easiest communication with the Skagerak through the deep eastern channel. Here the numbers of rays is 52.53 ± 0.36 (66 ind., all from the autumn of 1905). The population of this water is evidently a very mixed one, the distribution of the specimens among the individual numbers of rays being very scattered (see Table I) and σ being very high (2.94). In the western part of the northern Kattegat, the region between the Skaw and Læsø, the number of rays is considerably lower, viz. 51.38 ± 0.29 (85 ind.), being thus nearer to the mean figure of the "Baltic race" than to that of the North Sea race; here, too, the standard deviation is high (2.66). Evidently, the number of spawning plaice of the North Sea race is extremely low in some years: in 1907 and 1909 the anal fin rays amounted to only 50.78 (10 ind.) and 50.14 (28 ind.), respectively. This mixed character of the spawning stock of the Kattegat was already established by A. C. Johansen.

In other words the number of anal fin rays in spawning plaice of the northern Kattegat is about 52, that is to say halfway between the figures of the "Baltic race" and the North Sea race. In view of the fact that the young fish of the Aalbæk B. (see page 00) show the high figure of 54.0, it is evident that only a small part of them originate from the spawning in the northern Kattegat and that the bulk of them enter from the Skagerak. In the central part of the eastern Kattegat (Kobbergrund—St. Middelgrund) the number of rays is even somewhat lower, being here 51.06 ± 0.23 (134 ind.). In the Aalborg B. between Læsø and Djursland the number is still lower, viz. 50.45 ± 0.19 (136 ind.). In the southwestern Kattegat[1]), E. of Djursland, an investigation of some importance was carried out in two years only (1905 and 1939), in 1905 the number of anal fin rays was 50.21 (133 ind.) and in 1939 50.75 (24 ind.). The mean figure for both years from

[1]) In the calculations of the ray figure of plaice from the transplantation areas (the southern Kattegat, the Sound, the Belt Sea and the Western Baltic) were not included transplanted plaice (from the Horns Reef); the latter could easily and safely be distinguished from the rest by the very different look of their otoliths (see H. Blegvad, l. c.).

this area was 50.25 ± 0.15. To put it short we here find the same values as in the Belt Sea and the Western Baltic. In the Kattegat as a whole there is a distinct fall in the number of rays of the spawning fish from north to south: in the northern Kattegat the number of rays is about 51.5—52.5, in the southern Kattegat about 50—51. Throughout the Kattegat, with the exception of the northeastern portion (between Vinga and the Skaw), plaice of "Baltic" race are more conspicuous in the stock of spawning fish than plaice of the North Sea race. In the Aalborg B. the spawners nearly exclusively belong to the "Baltic race"; in this locality the intermixing is quite insignificant and the standard deviation, consequently, is low (1.87).

The Sound.

In the Sound the mean number of rays is 50.76 ± 0.11 or somewhat lower than in the eastern Kattegat, but higher than in the Aalborg B. There are some changes from year to year, the lowest figure observed being 50.31 (74 ind.), the highest (apart from a sample of only 7 ind. with 52.86) 51.38 (53 ind.). So there is a difference of about 1 between the two figures, which, strange to say, both date from the same spawning period, the winter 1921/22. From this spawning period we have the following 3 analyses, all originating from the same place of capture (off Skovshoved):

1st—4th Oct. 1921	50.31 ± 0.21	(74 ind.)
13th—14th Dec. 1921	50.82	(34 ind.)
9th—18th Mar. 1922	51.38 ± 0.30	(53 ind.)

This variation of the number of rays within the same spawning period seems to indicate that the stock of spawning fish in the Sound is rather inconstant and that in winter there is an immigration from the north of plaice with a high ray figure or an emigration towards the south of plaice with a low ray figure, or perhaps both.

The Belt Sea.

In the Belt Sea where the plaice will spawn in nearly all localities with sufficient depth of water the mean number of rays in the different areas is fairly uniform for all years collectively, ranging only between 50.39 and 51.02 (apart from Smaalandshavet where one analysis of only 16 ind. yielded a mean figure of 49.94). In the different areas (see Figure 1) the following mean figures were found:

Area	No.	M. of rays	m	σ	No. of ind.
Northernmost part of Belt Sea	1	50.90	± 0.19	2.15	127
N. of Funen—S. of Samsø	2	50.69	± 0.13	1.78	186
Northern part of Great Belt	3	50.54	± 0.09	2.14	563
Southern part of Great Belt—Langelands B.	4	50.39	± 0.13	2.02	260
Smaalandshavet	5	49.94	..	..	16
Southern part of Lesser Belt	6	51.02	± 0.15	2.11	187

The different spawning periods showed these numbers of rays (No. of ind. in brackets):

Spawning season	Area 1	2	3	4	6
1902-03	..	..	50.03(70)	50.25(40)	..
05-06	..	..	50.07(14)	..	..
08-09	..	..	..	49.73(52)	..
27-28	..	..	51.37(151)	..	..
29-30	..	..	..	50.16(44)	..
31-32	50.92(24)	50.28(43)	50.92(13)	..	51.39(28)
32-33	50.68(31)	50.79(14)	..	..	50.64(11)
33-34	..	50.69(49)	..	51.47(15)	..
34-35	..	51.73(11)	51.15(20)	..	51.06(64)
35-36	50.62(29)	..	50.44(43)	50.74(50)	50.60(20)
36-37	..	51.78 (9)	51.00 (8)	..	50.92(13)
37-38	53.00(16)	50.78(69)	50.00(68)	50.69(46)	51.36(28)

As will appear from this table there is some variation from year to year in the number of anal fin rays. The figures are comparatively low in the years between 1902 and 1909 and considerably higher in the years after 1927/28, more particularly in the spawning periods 1927/28, 1934/35, 1936/37 and, to some degree, 1937/38. One would think that the rise in the number of rays in the years after 1934/35 might be due to the spawning of North Sea plaice transplanted to the Belt Sea during recent years. The fact, however, that the rise appeared already in 1927/28, that is to say before the possible effects of the first transplantation in the spring of 1928, makes it obvious that the rise cannot with certainty be ascribed to the transplantation. We shall return to this question in a later section (page 00). Already in 1928 A. C. Johansen called attention to the rising number of rays in the years 1927/28 and put it down to an increased influx of larvae of the North Sea race.

The Western Baltic.

The spawning places found at the Danish coasts of the Western Baltic are principally situated in

the deep channel S. and W. of Langeland and in deeper water off the southern coasts of Lolland.

Analyses of spawning fish from these two areas are rather comprehensive; for all years collectively their mean figures are of the same height as those found in the Belt Sea[1]):

SW. of Langeland ..... 50.73 ± 0.08 (720 ind.)
S. of Lolland ..... 50.49 ± 0.14 (248 ind.)

So the number of anal fin rays is possibly somewhat lower S. of Lolland than W. of Langeland. In the area SW. of Langeland the individual spawning periods gave the following numbers of anal fin rays:

Spawning period	$19^{02}/_{03}$	$19^{05}/_{06}$	$19^{21}/_{22}$	$19^{22}/_{23}$	$19^{26}/_{27}$	$19^{27}/_{28}$
No. of rays	50.30	50.61	50.27	50.42	51.36	51.00
No. of ind.	37	77	140	12	83	191

Spawning period	$19^{31}/_{32}$	$19^{32}/_{33}$	$19^{35}/_{36}$	$19^{37}/_{38}$	$19^{38}/_{39}$	
No. of rays	50.93	50.11	50.30	50.30	51.15	—
No. of ind.	29	28	37	47	39	—

The extremities are here 50.11 and 51.15, and the values are highest in the spawning periods 1926/27, 1927/28 and 1938/39. The rise of the number of rays in the Belt Sea about 1927/28 also appears in the Western Baltic.

The ray figure for the area S. of Lolland shows a similar although less pronounced rise: on $^{24}/_{4}$ 1922 it was 50.30 (150 ind.), on $^{2}/_{3}$ 1927 it was 50.65 (88 ind.).

The number of anal fin rays found in the water SW. of Langeland, 50.73 (720 ind.), corresponds well with R. Kändler's (1935) figure for all plaice (young and older fish) examined in the Kieler B., 50.78 (695 ind.); for spawning fish alone Kändler gives the figure 50.72 (180 ind.). Also with respect to the individual year-classes there is a good correspondence between the two series: the highest number of rays, 51.07, is found by Kändler in the 0-Gr. of 1927, which goes well with the fact that the Danish examinations of spawning fish in the period 1926/27 yielded the high figure of 51.14.

[1]) But if we compare the individual spawning seasons, the figure of the Belt Sea is somewhat higher than that of the Western Baltic; for instance: 1927/28 Northern Great Belt 51.37 (151 ind.), Western Baltic 50.99 (191 ind.).

The Baltic Proper.

As is well-known the number of rays rises again in the Baltic Proper. In the Faxe Bay, the north-western corner of the Baltic, the ray figure is still low[1]), 50.63 ± 0.20 (125 ind.), or the same as in the Sound and the Western Baltic; but already in the water S. of Møen and E. of Falster the figure is considerably higher: for all years collectively 366 spawning fish here show the ray figure 51.16 ± 0.12. The figures of the individual spawning periods are as follows:

4th April, 1895 ..... 50.89 (36 ind.)
Feb.—Mar., 1903 ..... 51.01 (172 ind.)
10th—11th May, 1928 ..... 51.39 (158 ind.)

In this water, too, the number of anal fin rays was comparatively high in 1928.

Analyses of mature fish from the water round Bornholm have been carried out during the last few years only; of analyses of spawning fish we have but one (see Summary 3).

Summary 3.

10—12 naut. miles N. by W. of Rønne, 18-VIII-1928, Mat. IV and VIII	51.81 (84 ind.)	51.70 ± 0.20 (123 ind.)
12 naut. miles S. by E. of Rønne, 20-VIII-1928, Mat. IV and VIII	51.43 (39 —)	
4 naut. miles E. of Nexø, 25-VIII-1928, Mat. IV and VIII	51.38 (69 —)	51.10 ± 0.16 (178 ind.)
14 naut. miles S. of Nexø, 21-I-1931, Mat. V—VI and VI	50.92 (109 —)	
At Christiansø, 24-VI-1935, Mat. V—VIII	52.12 (44 —)	

On the whole the number of anal fin rays is here somewhat higher than E. of Falster.

For the Bornholm Deep E. and S. of Nexø the ray figures found here are lower than those given by R. Kändler (1935, 51.78); however, the analysis from Christiansø shows a comparatively high value. On the whole the number of anal fin rays in this water seems to vary somewhat from year to year: 1931—50.91, 1928—51.36, 1935—52.12. For the

[1]) The investigations date from the years 1895—97, and so they are not fully comparable with the analyses from the other waters, which, besides older material, also include analyses from the years after 1927 (with comparatively high ray figures).

Arkona Basin (51.70 rays) there is a good correspondence: R. Kändler gives the figures 51.55 for the water W. of Rügen and 51.69 for the water E. of Falster.

Summary.

The number of anal fin rays in spawning plaice of the North Sea is about 54.0. In the Skagerak the figure is a little lower, 53.7 at Hirshals and 53.2 N. of the Skaw. Some variation of the ray figure from year to year, between about 52.5 and 54.5, occurs N. of the Skaw: the spawning stock of this area is in certain years to some degree intermixed with plaice from the inner Danish waters. In the Kattegat the number of rays falls rapidly from north to south, from about 52.5 to about 50.3 In no locality of the Kattegat—not even in the northernmost part—do we find a comparatively pure stock of spawning plaice of the North Sea race; in the southwestern region (the Aalborg B.) the spawning stock is even of pure Belt Sea race. In the Sound the number of rays (50.8) is somewhat lower than in the eastern Kattegat; variations are found even within the same spawning period (from 50.3 in Oct. 1921 to 51.4 in March 1922); this fact seems to be indicative of rather extensive migrations of spawning plaice into or through the Sound. In the Belt Sea the number of rays is rather constant from one area to another, ranging between 50.4 and 51.1; in Smaalandshavet one small sample showed a number of only 49.9. The changes from year to year are somewhat greater, from 49.7 to 51.4; in the years between 1902 and 1909 the figures observed were considerably lower than in the years between 1927 and 1935. This rise of the number of rays can be only partially due to the spawning of the transplanted North Sea plaice inside the area. In the Western Baltic the ray figure is a little below that of the Belt Sea. There is some change from year to year (50.1—51.1), and here, too, the number of rays is higher between 1927 and 1932 than in the years before. In the western part of the Baltic Proper the number of rays is somewhat higher (about 51) than in the Western Baltic and the Sound. In the inner regions of the Baltic (round Bornholm) the number runs as high as 52.1; the changes from year are illustrated by the figures 50.9 in 1931 and 52.1 in 1935.

On the Number of Anal Fin Rays in Young Plaice of Different Waters.

Among "young plaice" are in this case reckoned all individuals that have not yet attained maturity. Therefore the range of the term "young plaice" differs widely from one water to another: in the North Sea it includes plaice of the 0- to the V- or VI-Gr., in the Belt Sea principally plaice of the 0- and I-Gr.

Most of the material of this investigation originates from fishings with Johansen's Young Plaice Trawl along the coasts of the waters within Hirshals, this portion mainly consisting of 0-Gr. and, to a less degree, of I-Gr. For the supplementation of this material were included analyses of plaice caught with the eel-seine from the research vessel of the Danish Biological Station or bought from commercial fishermen. The North Sea material nearly exclusively originates from captures in the Horns Reef Area and the water round Thyborøn of young plaice for the transplantations.

During the work the main stress was laid on the material from the years after 1928, but when it was considered expedient, material from earlier years was drawn into the investigation. Most of these older analyses have already been published (A. C. Johansen, 1928 and previous publications).

The North Sea.

As part of the scientific investigations connected with the transplantations of plaice from the Horns Reef Area to the Belt Sea a series of countings of anal fin rays in young plaice was carried out between 1933 and 1938, principally dealing with fish of the II—VI-Gr., caught at depths between 4 and 10 m. from Slugen past Skallingen to the water SW. of Fanø (Table 1).

Table 1.

Year	1933	1934	1935	1936	1937	1938	Total
No. A. F. R.							
47	..	..	..	4	..	..	4
48	1	..	1	6	..	..	8
49	2	4	7	22	5	8	48
50	5	9	13	39	21	19	106
51	15	32	32	116	45	49	289
52	26	47	52	243	74	84	526
53	31	56	74	374	138	113	786

(continues)

Table 1 (continued).

Year	1933	1934	1935	1936	1937	1938	Total
No. A. F. R.							
54	30	79	82	394	171	179	935
55	24	81	61	344	149	125	784
56	21	40	57	216	86	98	518
57	7	24	35	119	59	46	290
58	8	17	15	65	29	22	156
59	2	2	9	13	13	6	45
60	..	1	..	4	..	..	5
61	..	..	..	..	..	2	2
62	..	..	1	..	..	..	1
63	..	..	..	1	..	..	1
Total	172	392	439	1960	790	751	4504
Mean	53.80	54.04	54.06	53.98	54.19	54.06	54.03

The mean figure for all analyses is 54.03 ± 0.02 (4 504 ind.). Figure 2 shows the graph representing the variation of the numbers of anal fin rays in these 4 504 individuals. The standard deviation is 2.02. The said mean figure corresponds excellently with the one found for mature fish in the same area (54.04—26 ind.), but in somewhat deeper water.

The numbers of rays in the analyses carried out in the years 1934, 1935, 1936 and 1938 are fairly the same (54.04, 54.02, 54.02 and 54.06, respectively). In the analysis from 1933 the ray figure is a little lower (53.80), in the 1937 analysis somewhat higher (54.20). In other words the difference between the ray figures of the various years is very small. But

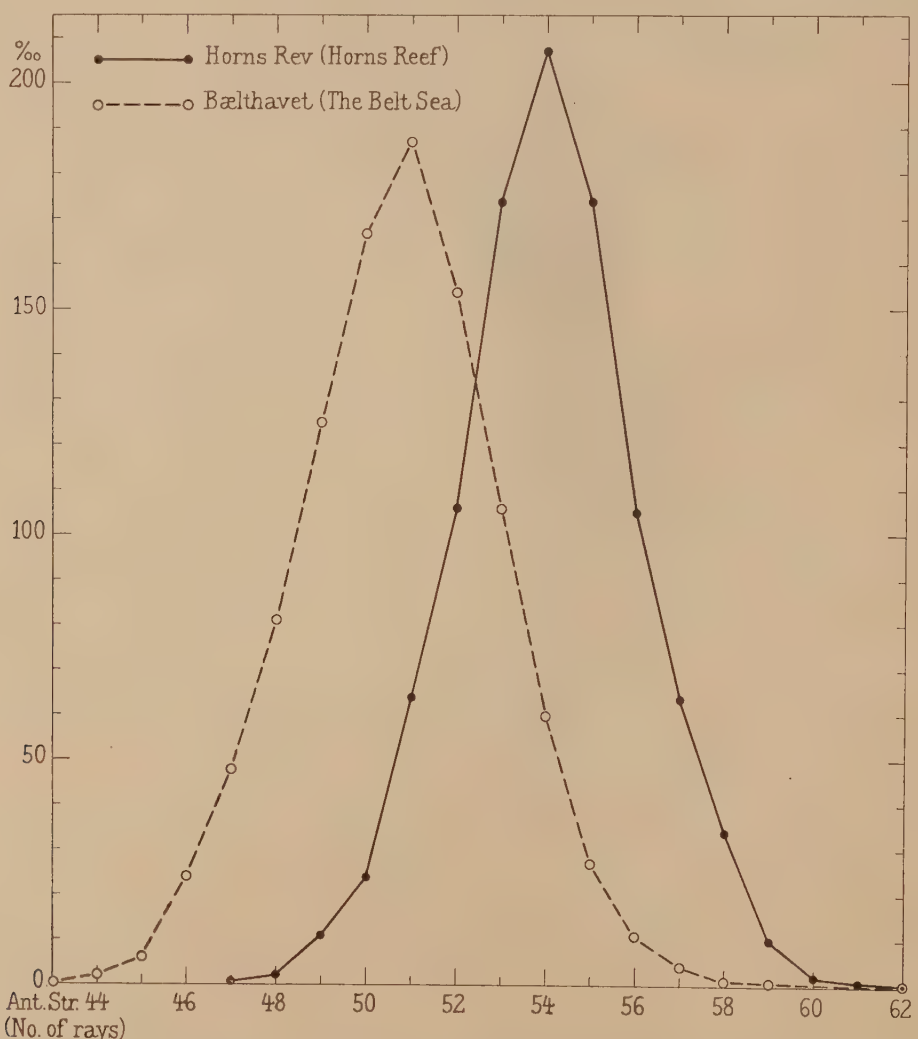

Fig. 2. Graphs representing the variation of the number of anal fin rays (calculated per 1 000 ind.) in plaice from the Horns Reef Area (Table 1—4 504 ind.) and from the Belt Sea (Table in the text of page 00—13 113 ind.).

we are not allowed to conclude from this fact that the number of rays in the North Sea plaice is constant from year to year. If we arrange the material by year-classes (see Table II, page 68), we get another picture with distinct variations as will appear from the following survey:

Year-class	Mean	No. of ind.	Diff. from M.
1928	53.81	404	÷ 0.22
1929	53.92	208	÷ 0.11
1930	54.03	214	..
1931	53.67	258	÷ 0.36
1932	54.82	576	+ 0.79
1933	53.75	1327	÷ 0.28
1934	54.18	773	+ 0.15
1935	54.12	683	+ 0.09
1936	53.72	53	÷ 0.31
All year-classes	54.03	4504 (4496)	..

The year-classes 1928, 1931, 1933 and 1936 show a comparatively low number of anal fin rays; 1929, 1930 and 1935 are rather near the mean figure while the year-classes 1932 and, to a less degree, 1934 have high numbers. The range of variation within the year-classes dealt with here is 1.15 ray. R. Kändler (1935) has published a series of analyses of the number of anal fin rays in young plaice from the neighbouring German Bay; on the whole these analyses correspond rather well with those from the Horns Reef Area:

Year-class	1928	1929	1932
Horns Reef Area	53.81 (404)	53.92 (208)	54.82 (576)
German B. (Kändler)	53.42 (382)	53.53 (204)	55.00 (206)
Horns Reef as compared to German B.	+ 0.39	+ 0.39	÷ 0.18

Also in the German B., then, the 1932 year-class shows a higher number of rays in comparison with the two other year-classes examined (1928 and 1929), the difference being even considerably greater than in the Horns Reef Area. This difference in the number of rays between the two regions is possibly a consequence of their being populated by fry from different spawning areas; but this question cannot yet be answered because no investigations have been carried out concerning the numbers of rays in plaice spawning in the different parts of the North Sea. It remains to be said that the number of rays for the 1932 year-class in the Horns Reef Area (54.82) is about halfway between the figures found by Kändler for the same year-class: North Sea coast of Scotland 54.59, German Bay 55.00.

From the area some way northward of the Horns Reef, the coastal waters off Thyborøn, a series of countings of anal fin rays in young plaice caught for transplantation was carried out between 1935 and 1938; the results were as follows:

Table 2.

No. A. F. R.	1935	1936	1937	1938	Total
44	..	..	..	1	1
45	..	..	..	..	..
46	..	..	..	..	..
47	..	..	..	1	1
48	3	..	3	1	7
49	4	4	11	6	25
50	14	10	22	26	72
51	24	31	67	64	186
52	54	52	127	125	358
53	76	117	217	193	603
54	90	119	232	207	648
55	95	107	190	205	597
56	70	64	141	124	399
57	36	40	72	59	207
58	19	17	26	31	93
59	8	6	18	10	42
60	2	1	5	..	8
61	..	1	..	2	3
Total	495	569	1 131	1 055	3 250
Mean	54.24	54.16	54.05	54.03	54.10

Simultaneously with these analyses of plaice from the North Sea off Thyborøn countings were made of some young plaice caught in the Nissum Broad, that is to say in the Limfjord immediately inside the Thyborøn:

Table 3.

No. A. F. R.	1935	1936	1937	1938	Total
47	..	1	..	..	1
48	1	2	..	1	4
49	4	3	1	5	13
50	12	15	8	10	45
51	24	30	28	20	102
52	50	66	52	30	198
53	71	92	65	55	283
54	66	122	72	56	316
55	61	89	67	57	274
56	40	55	54	29	178
57	19	28	22	16	85
58	12	11	18	4	45
59	1	4	4	1	10
60	1	..	2	..	3
61	..	1	1	..	2
Total	362	519	394	284	1559
Mean	53.83	53.89	54.14	53.78	53.93

The material from the Thyborøn Area and the Nissum Broad was put down in Tables III and IV (pages 68 and 70).

In the survey below the individual year-classes of the areas Horns Reef, off Thyborøn and Nissum Broad are compared with regard to ray figures; No of specimens in ( ).

Year-class	Horns Reef	Off Thyborøn	Nissum Broad	Variation
1931	53.67 (258)	53.44 (87)	..	0.23
1932	54.82 (576)	54.70 (327)	54.68 (144)	0.14
1933	53.75 (1327)	53.99 (679)	53.65 (593)	0.34
1934	54.18 (773)	54.19 (683)	54.17 (236)	0.02
1935	54.12 (683)	54.10 (943)	54.04 (384)	0.08
1936	53.72 (53)	53.83 (515)	53.67 (191)	0.16

As will appear from the comparison the numbers of anal fin rays in the 3 areas are very much the same. For the 1933 year-class, only, the figure is somewhat higher in the North Sea off Thyborøn than in the Horns Reef Area and the Nissum Broad, the difference being + 0.24 and + 0.34, respectively. In the rest of the year-classes the variation is extremely small. The figures of the Nissum Broad are a little below those of the Thyborøn Area, and altogether those of the latter area (apart from the 1933 year-class) are again slightly lower than the figures of the Horns Reef Area. A fall—although a most inconsiderable one—of the ray figure is thus observed from the North Sea into the Nissum Broad. From the Nissum Broad to the adjacent central regions of the Limfjord (Lavbjerg Broad, Venø B., Kaas Broad and Salling Sound) another inconsiderable fall is noticed (the material originates from fishings with the eel-seine, carried out by the Biological Station).

Year-class	Age group	Nissum Br.	Central Limfjord	Nissum Br. minus Centr. Limfjord
1935	I-	54.13 (144)	54.30 (40)	÷ 0.17
	II-	54.10 (182)	53.98 (102)	+ 0.12
1936	0-	53.90 (263)	53.42 (41)	+ 0.48
	I-	53.82 (204)	53.79 (195)	+ 0.03
1937	0-Gr.	53.99 (106)	53.88 (8)	+ 0.11

Thus the difference of ray figures between the North Sea and the adjacent parts of the Limfjord is extremely small, which accords with the fact that the plaice population of the Limfjord is recruited from the North Sea. The plaice does not spawn in the Limfjord, nor is there any immigration into this water from the Kattegat.

We have seen that the regions of the North Sea (with the Nissum Broad) examined here show an extremely small variation of the ray figure from place to place. Within the same year-class the greatest variation observed was only 0.34 ray, and in most cases the variation was even much lower (cp. survey above). So there cannot be any doubt that the whole area is populated by the same race. As illustrated above, however, the number of anal fin rays of this race is subject to considerable annual variations. The greatest differences in ray figure between the individual year-classes are

in the Horns Reef Area:
1.15 ray ± 0.11 (1932 year-class minus 1931 year-class)
off Thyborøn:
1.26 ray ± 0.11 (1932 year-class minus 1931 year-class)
in the Nissum Broad:
1.03 ray ± 0.11 (1932 year-class minus 1933 year-class)

The problems attaching to the causes of these variations in the number of anal fin rays from one year-class to another will be dealt with by another investigator, and no further details will therefore be advanced here.

The Skagerak.

Some countings of anal fin rays in young plaice from the Skagerak are in hand from the years after 1923, and in Tabel V they have been arranged by year-classes. The mean figure for all analyses is 54.01 ± 0.04 (3 245 ind.) or nearly the same as in the Horns Reef Area (54.03), in the coastal waters at Thyborøn (54.10) and in the Nissum Broad (53.93). The stock of plaice growing up along the Skagerak coast of Jutland thus shows the same racial character as the plaice of the North Sea coast: it belongs to the North Sea race. The survey gives the mean ray figures of the individual year-classes:

Year-class	Mean	No. of ind.	Diff. from M.
1928	53.85	270	÷ 0.16
1929	53.41	39	÷ 0.60
1932	54.57	23	+ 0.56
1933	53.87	204	÷ 0.14
1934	54.42	756	+ 0.41
1935	54.08	1089	+ 0.07
1936	53.45	431	÷ 0.56
1937	53.86	412	÷ 0.15
1938	54.22	21	+ 0.21
All year-classes	54.01	3245	..

The deviations from the mean are not great, being of fairly the same size as in the Horns Reef Area and the coastal waters off Thyborøn. The range of

variation in the ray figure of the year-classes examined is 1.16 against 1.15 in the Horns Reef Area and 1.26 off Thyborøn, or nearly the same as in these two areas. The coefficient of variation (σ) for all year-classes collectively is 2.03. So there is nothing to show that the young plaice of the Skagerak coast mingle with plaice of another race (from the Kattegat).

In the following survey the numbers of anal fin rays of the different year-classes have been arranged together with the results of analyses from the different parts of the North Sea; No. of specimens in ( ):

Year-class	The Horns Reef	Off Thyborøn	The Skagerak	The Nissum Br.
1928	53.81 (404)	..	53.85 (270)	..
1929	53.92 (208)	53.44 (87)	53.41 (39)	..
1932	54.82 (576)	54.70 (327)	54.57 (23)	54.68 (144)
1933	53.75 (1327)	53.99 (679)	53.87 (204)	53.65 (593)
1934	54.18 (773)	54.19 (683)	54.42 (756)	54.17 (236)
1935	54.12 (683)	54.10 (943)	54.08 (1089)	54.04 (384)
1936	53.72 (53)	53.83 (515)	53.45 (431)	53.67 (191)

It appears distinctly from the survey and from Figure 3 that the variation of the year-classes follows the same course in the Skagerak as in the North Sea: in both waters the year-classes 1928, 29, 33 and 36 show a comparatively low, the year-classes 1932, 34 and 35 a comparatively high ray figure.

Although—as mentioned above—the Skagerak coast as a whole has much the same ray figure as the North Sea, there seems to be a slight fall of this figure from SW. to NE. It is true that this fall does not appear from a comparison of all year-classes and analyses collectively from the two areas because we then get these figures:

The Jammer Bay (S. W.) ..... 53.93 (807 ind.)
The Tannis Bay (N. E.) ..... 54.04 (2 438 ind.)

but a comparison of year-classes gives the following result (see Summary 4).

In some cases the number of individuals examined is rather small, but the fact that the Tannis B. in

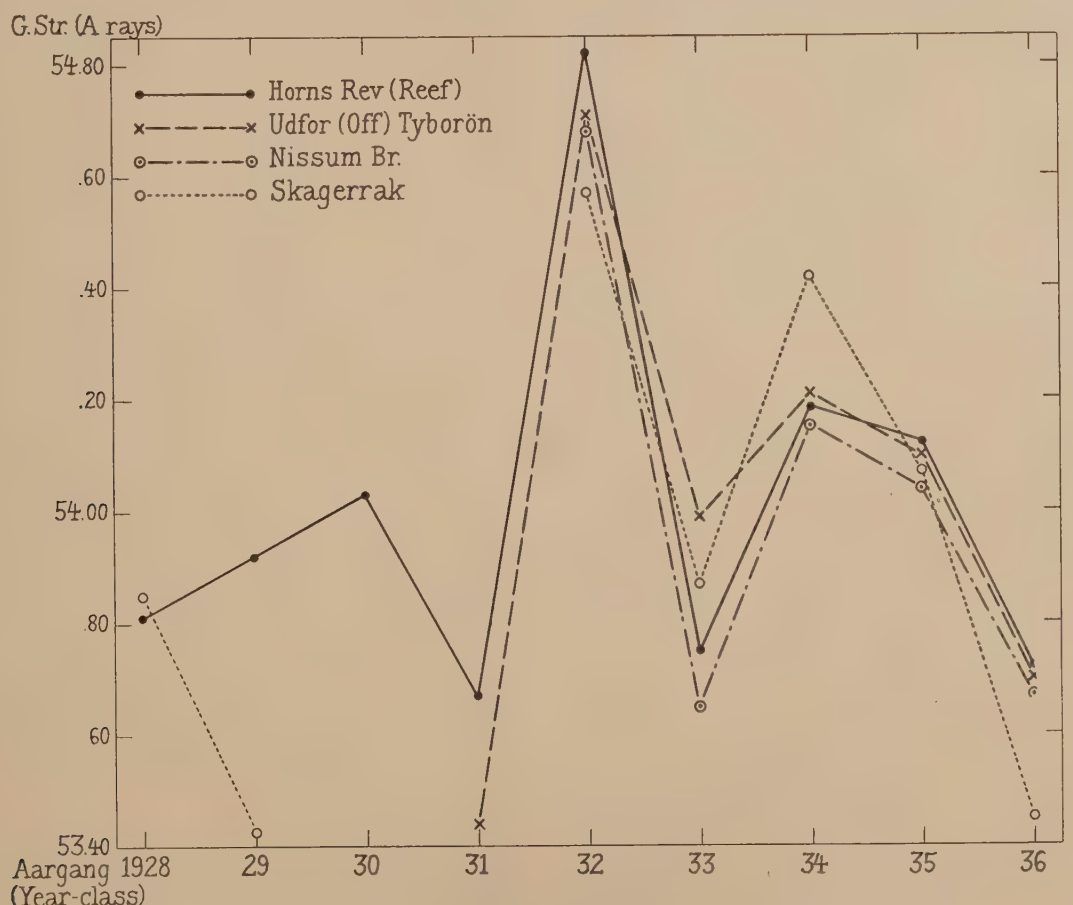

Fig. 3. Mean numbers of anal fin rays in various year-classes of plaice from the Danish coasts of the North Sea and the Skagerak.

Summary 4.

Year-class	Gr.	The Jammer B.	The Tannis B.	Difference (J. B. minus T. B.)
1928	II	53.79 (144)	53.91 (126)	÷ 0.12
1929	I	53.47 (17)	53.36 (22)	+ 0.11
1935	I	54.06 (79)	53.78 (193)	+ 0.28
1935	III	54.34 (129)	54.00 (48)	+ 0.34
1936	0	53.43 (65)	53.06 (111)	+ 0.37
1936	I	53.46 (57)	53.43 (114)	+ 0.03
1937	0	53.98 (226)	53.66 (100)	+ 0.32
1937	I	53.82 (67)	53.75 (12)	+ 0.07

7 out of 8 comparisons has a lower figure than the Jammer B. shows us that a fall of the ray figure actually takes place from SW. to NE. along the coast of the Skagerak. This observation accords with the analyses of spawning fish from the Skagerak, in which the mean figure was found to be 53.68 (56 ind.) off Hirshals, but only 53.17 (196 ind.) N. of the Skaw. Though the Skagerak as a whole does not show any fall of the ray figure, such a fall appears in the coastal area that borders on the Kattegat; in other words the young fish of this area—although to a small degree only—mingle with Kattegat fish with a lower ray figure. Another interesting feature is the fact that the number of rays is higher in the young fish of the Tannis B. than in the spawning fish of the same water, the mean of the spawning fish (see Table I) being 53.17, that of the young fish 54.04. This fact also appears from a comparison of year-classes: in March 1928 the spawning fish of the Tannis B. had a ray figure of 53.29 (73 ind.), the young fish of 1928, however, had 53.91 rays (126 ind.) as II-Gr. in 1930. We see from this that the young fish of the Tannis B. are recruited not only from the spawning occurring inside the same area, but also from an immigration of young fish from the western Skagerak and the North Sea.

As will appear from the facts advanced above there is but a slight difference between the numbers of anal fin rays from the areas examined in the North Sea and the Skagerak. Undoubtedly, this is because the fry at the various parts of the western coast of Jutland do not arrive from a few isolated neighbouring spawning places, but are carried to the coast by the marine currents and, consequently, are composed of larvae from the spawning places of far and near. The small variations of the ray figure from year to year and from place to place may be due partly to the annual variation of the conditions in which the eggs and tiny fry are living, partly to the fact that the currents one year will carry in fry from one spawning place, the next year from another. The northerly current along the western coast of Jutland further contributes to efface possible local variations of the ray figure.

The Kattegat.[1])

a. Northernmost Kattegat (N. of Frederikshavn).

Among the young fish along the western coast of Jutland from Fanø to the Skaw the variation of the ray figure is extremely small, but when we round the Skaw and enter the Aalbæk Bay, we find a distinct fall of the figure. As far as the 0- and I-Groups are concerned the material presented below is available for comparisons (No. of ind. in brackets):

Year-class	Gr.	The Tannis B. (Skagerak)	The Aalbæk B. (Kattegat)	Tannis B. ÷ Aalbæk B.
1904	I	54.11 (449)	54.01 (274)	+ 0.10
1905	0	54.19 (206)	54.04 (77)	+ 0.15
1905	I	54.30 (173)	54.22 (538)	+ 0.08
1906	0	54.19 (206)	51.64 (419)	+ 2.55
1906	I	..	53.84 (596)	..
1924	0	54.30 (80)	54.25 (186)	+ 0.05
1929	I	53.36 (22)	54.15 (312)	÷ 0.79
1934	0	54.30 (96)	53.86 (569)	+ 0.44
1934	I	54.48 (432)	54.11 (470)	+ 0.37
1935	0	54.64 (81)	53.99 (239)	+ 0.65
1935	I	53.78 (193)	53.78 (152)	=
1936	0	53.06 (111)	53.55 (119)	÷ 0.49
1936	I	53.43 (114)	53.57 (255)	÷ 0.14
1937	0	53.66 (100)	53.74 (174)	+ 0.02
1937	I	53.68 (19)	53.75 (119)	÷ 0.07
1938	0	54.16 (12)	53.58 (66)	+ 0.58

In 10 out of 15 analyses the figures of the Tannis B. are higher than those of the Aalbæk B., one year even showing the difference of 2.55; and only 4 out of 15 analyses have lower figures in the Tannis B. Evidently, a certain mixing with fry from a plaice population with lower ray figures takes place already in the northernmost part of the Kattegat and may be very distinct in certain years. The 0-Gr. sample from 1906 is particularly interesting because it exhibits a considerable difference of ray figures inside the Aalbæk B. This sample originates from 3 different localities (A. C. Johansen, l. c., 1928), viz.

[1]) The numbers of anal fin rays in the 0- and I-Gr. material from the coastal investigations inside the Skaw are given in Tables VI a and VI b, p. 72 and 73 (the various coastal areas, K_1 etc., are marked off on the map, Figure 10, p. 55).

Northernmost part of the Aalbæk B., S. of the Skaw	52.57	(70 ind.)
Central part of the Aalbæk B., off Aalbæk	51.55	(324 ind.)
Southern part of the Aalbæk B., N. of Frederikshavn	50.24	(25 ind.)

Even inside this small area, which is no more than 15 naut. miles in extent, there is a distinct fall in the number of anal fin rays from north to south, and already in the southern part of the Aalbæk B. we thus have a ray figure in the said year that is just as low as the normal of the Western Baltic. Evidently, the 0-Gr. of the Aalbæk B. is in this year distinctly of mixed origin; this mixed character appears plainly from Figure 4, which represents the distribution of the number of anal fin rays of the 0-Gr., calculated per 1,000 individuals in the Aalbæk B. and the Tannis B. for the year 1906. For the Aalbæk B. the graph is broad and flat with approximately the same number of individuals within all values of ray figures between 48 and 54; for the Tannis B. the graph is very narrow and high with a distinct apex at 54—55 rays. The apex of the Tannis B. graph is higher than might be expected from a pure race; this kind of graphs, however, is considered rather frequent for the North Sea plaice (Kändler, l. c., 1935). The mixed character of the sample from the Aalbæk B. also appears from the great width of variation, σ — 3.17, the variation in the corresponding sample from the Tannis B. being only 2.06.

It is interesting to note that in the Aalbæk B. it is only the 0-Gr. of the 1906 year-class that has a low ray figure (51.64): already the I-Gr. has a comparatively high number of rays (53.80); evidently, an extensive immigration of $^1/_2$- and $1^1/_2$-year-old individuals has taken place between the summers of 1906 and 1907.

From the Aalbæk B. we have the following investigations on the numbers of anal fin rays of the 0-Gr. from the individual years (see Summary 5).

The lowest figure is 51.64 (1906 year-class), the highest 54.80 (1932 year-class). The variation is 3.16, i. e. much greater than in the Skagerak and at the coast of the North Sea (about 1—1.5). The mean figure of these 16 year-classes from the Aalbæk B. is 53.8 or nearly 0.2 lower than in the Skagerak and the coastal waters of the North Sea.

It is a well-known fact that the Aalbæk B. is an exceedingly important nursery ground for the plaice population of the Kattegat: nowhere else in the Kattegat do we find so dense a stock of 0- and I-Gr. as in this very locality. As will appear from the facts mentioned above this stock of young fish is of somewhat different origin in the different years: in quite a few years the racial character of the Belt Sea fish prevails in the 0-Gr., but in most years the North Sea fish predominate. In the 1906 year-class the ray figure is closer to 50 than to 54; the year-classes 1907, 1928, 1931 and 1938 have between 53.0 and 53.5 anal fin rays. The rest of the year-classes have a mean of more than 53.5 rays, and the year-classes 1905, 1924, 1927, 1932 and 1935 have just about 54.0 rays or more, i. e.: they consist nearly exclusively of North Sea fish. Particularly high numbers of rays are found in the 1932 and 1924 year-classes (54.80 and 54.25, respectively).

Summary 5.

Year	No. of rays	No. of ind.
1905	54.04	77
1906	51.64	419
1907	53.32	158
1924	54.25	186
1927	54.01	155
1928	53.24	249
1929	53.86	121
1930	53.50	231
1931	53.15	106
1932	54.81	977
1933	53.86	81
1934	53.86	569
1935	53.99	239
1936	53.55	119
1937	53.74	174
1938	53.58	66

Before we look more closely into the causes of these annual variations in the number of anal fin rays, we will draw a comparison between the ray figures of young fish and spawning fish for the purpose of throwing a light on the origin of the rich population of young fish in the Aalbæk B., so that we may learn whether — as stated above — it consists principally of fry carried in from the North Sea and the Skagerak or comes from the spawning places of the northern Kattegat.

On the basis on his observations of a higher number of anal fin rays in the I-Gr. than in the 0-Gr. A. C. Johansen (l. c., 1910) pointed out that a considerable immigration of young plaice ($^1/_2$—$1^1/_2$ years old) from the Skagerak into the Aalbæk B. occurs at any rate in certain years. In certain

localities of the northern Kattegat he thus found a distinct rise of the ray figure from the 0- to the I-Gr. within the year-classes 1905 and 1906. For the illustration of this problem of the Aalbæk B. the material available is much larger now than in 1910, analyses of both 0- and I-Gr. having been carried out for the following year-classes (the 0-Gr. material originates exclusively from the coastal fishings with Johansen's Young Fish Trawl; as far as the I-Gr. is concerned the year-classes 1932—37 have been

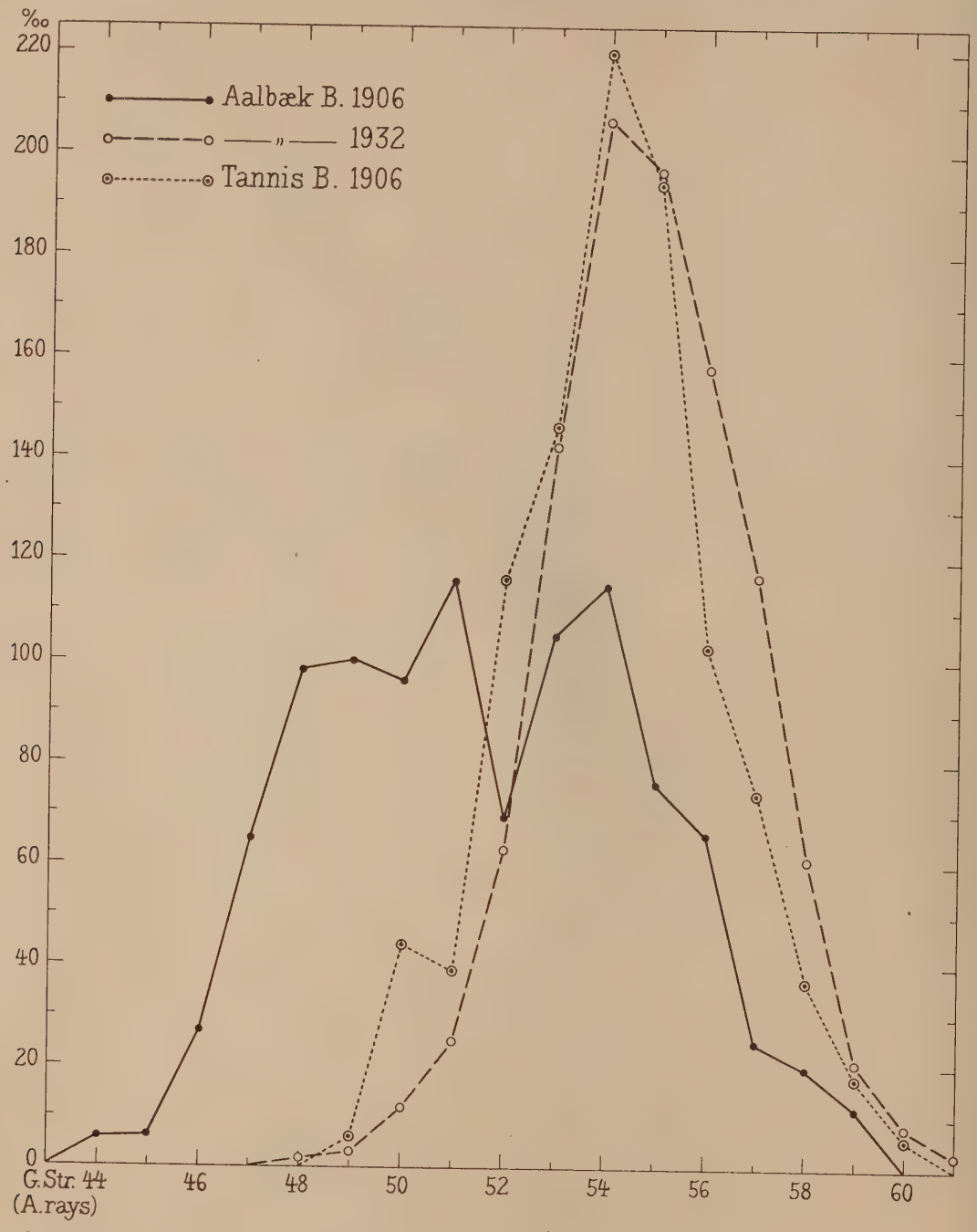

Fig. 4. Graphs representing the variation of the number of anal fin rays (calculated per 1,000 ind.) in 0-Gr. plaice from the Aalbæk B. in 1906 and 1932 and from the Tannis B. in 1906.

supplemented with material from the eel-seine fishings of S/S Biologen):

Year-class	0-Gr.	I-Gr.	I-Gr. ÷ 0-Gr.
1905	54.04 (77)	54.22 (538)	+ 0.18
1906	51.64 (419)	53.84 (596)	+ 2.20
1928	53.24 (249)	54.15 (312)	+ 0.91
1929	53.86 (121)	53.74 (39)	÷ 0.12
1930	53.50 (231)	53.74 (160)	+ 0.24
1931	53.15 (106)	53.23 (61)	+ 0.08
1932	54.80 (977)	54.63 (543)	÷ 0.17
1933	53.86 (81)	53.93 (195)	+ 0.07
1934	53.86 (569)	54.12 (470)	+ 0.26
1935	53.99 (239)	53.77 (152)	÷ 0.22
1936	53.55 (119)	53.57 (255)	+ 0.02
1937	53.74 (174)	53.75 (119)	+ 0.01

It appears from the survey that a fairly considerable rise of the ray figure from the 0- to the I-Gr. is noticed only in certain year-classes (1906 and 1928). However, this is sufficient proof to the fact that an immigration into the Aalbæk B. of fish with a higher number of rays, that is to say from the Skagerak or the North Sea, does take place, at any rate in certain years. If we calculate this immigration for the 1906 year-class, which shows the greatest difference of ray figures, we see that an immigration of plaice with 54.1 rays must be 9 times as large as the stock of 0-Gr. in 1906 in order to cause a rise to 53.84 in the I-Gr. in 1907. In other words an extensive immigration of $^1/_2$- and $1^1/_2$-year-old plaice from the Skagerak into the northern Kattegat undoubtedly occurs in certain years. The fact that the ray figure of the I-Gr. of several year-classes is but little above (the year-classes 1931, 1933 and 1934) or even below (the 1929 and 1935 year-classes) that of the 0-Gr. does not prove that an immigration of $^1/_2$- to $1^1/_2$-year-old fish did not also take place in the case of these year-classes, for it might well be supposed that the 0-Gr. already possessed so high a ray figure, that an immigration of North Sea fish could raise it no further — or at any rate could raise it to a very small degree only. But also in another way — by a comparison between the ray figures of the young fish and the spawning fish — we are led to the supposition that the bulk of the young fish population of the Aalbæk B. originates from without because it is recruited principally by an immigration of larvae and young bottom stages of the 0-Gr.

For all year-classes examined (see page 17) the mean number of anal fin rays in the 0-Gr. of the Aalbæk B. is about 53.8. The analyses of spawning fish are unfortunately rather few in number (see page 8). In the deep eastern part of the Kattegat (Læsø—Vinga) the number of rays is 52.53 (66 ind.), and in the water between Læsø and the Skaw it is 51.36 (84 ind.). The mean of the two areas collectively is 51.86 (150 ind.). So the difference between the young fish of the Aalbæk B. and the spawning fish from the spawning places in the northernmost part of the Kattegat is 2, and this considerable difference clearly shows that only a fraction of the young fish (0-Gr.) of the Aalbæk B. can be traced back to the spawning places of the northern Kattegat: most of them must have come from the spawning localities of the Skagerak and the North Sea. The nearest spawning place of the Skagerak is situated immediately N. of the Skaw (see page 7); here the number of anal fin rays (mean of a series of years) is 53.15 (194 ind.). Off Hirshals a ray number of 53.88 (58 ind.) was observed. Thus the ray figure is still comparatively low N. of the Skaw, and at any rate a minor part of the young fish must evidently have come from places situated still farther away, from the western Skagerak and the North Sea where the ray figures reach a height of 54.0 or more. For the rest it is a conspicuous fact that in 1928, the only year from which we have fairly numerous analyses of spawning fish, there is a particularly close correspondence between the ray figure of the spawning fish N. of the Skaw (March 1928, 53.25 (73 ind.)) and that of the 0-Gr. in the Aalbæk B. (July 1928, 53.27 (249 ind.)). On the basis of the mean numbers of rays in the fry and the spawning fish we are able to calculate a figure representing the ratio between the indigenous and the immigrated individuals of the 0-Gr. in the Aalbæk B. (for the spawning fish in the waters outside the Skaw the ray figure is put at 54.1, in the northern Kattegat at 51.9, and the young fish of the Aalbæk B. have 53.8 rays). The result of the calculation is that about 10 per cent. of the fry originate from the northern Kattegat and 90 per cent. from the waters outside the Skaw. So it is obvious that the spawning places of the northern Kattegat are of rather inferior importance for the maintenance of the young fish population of the Aalbæk B. and the adjacent regions of the northern Kattegat, and that this population is principally recruited from the waters outside the Skaw. The renovation takes place partly as an influx of larvae (and possibly of eggs), partly as an immigration of 0- and I-Gr. individuals. This

influx and immigration is induced by the current that follows the western coast of Jutland in a northerly direction, goes east round the Skaw and south into the Kattegat. As will appear from the representation on page 17 of the ray figures of the two conditions are compared in Figure 5. The salinity figures are the mean figures for the months of February, March and April, that is to say the months in which the pelagic eggs and larvae of the plaice are commonly found. The figure shows a

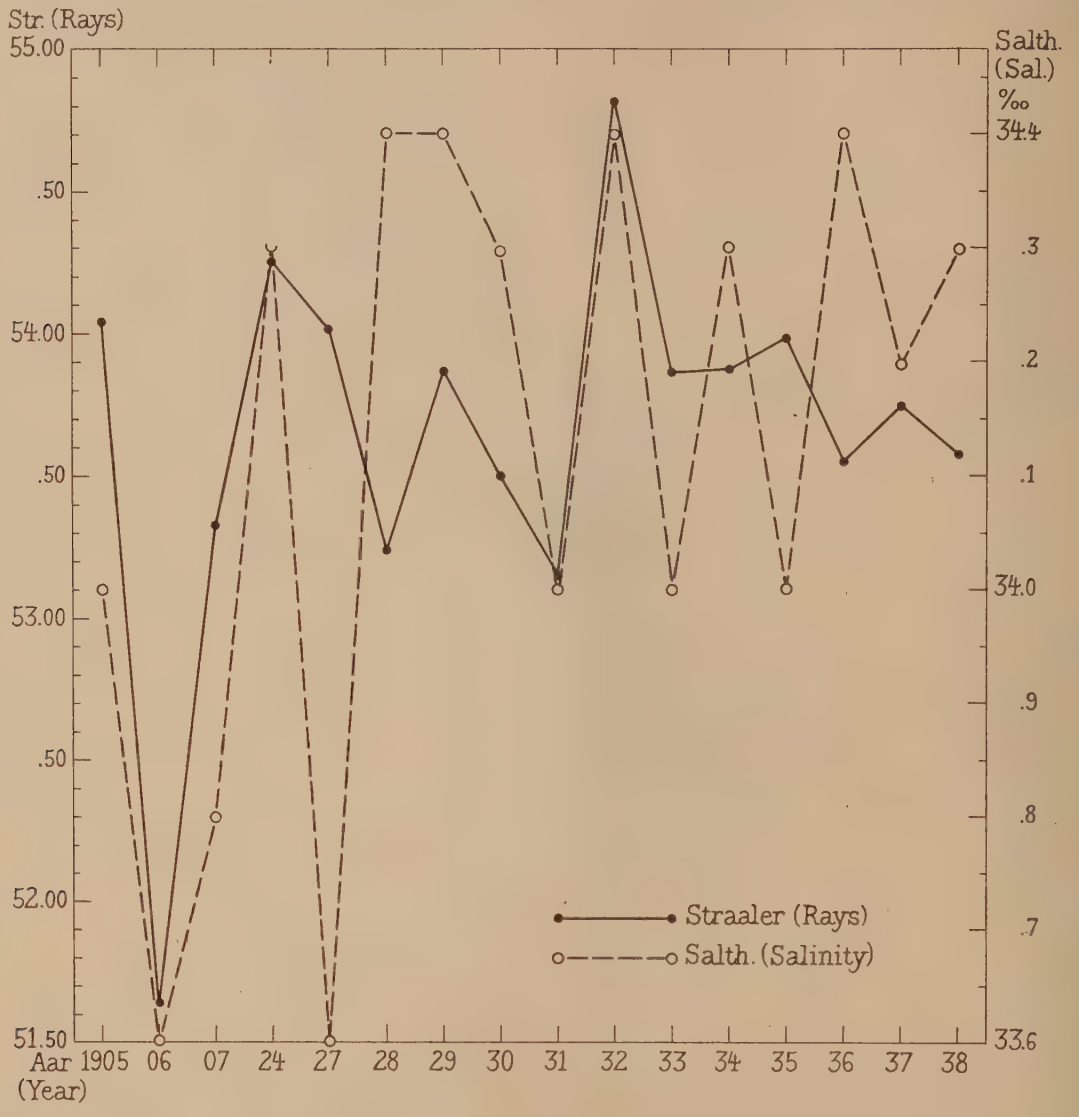

Fig. 5. Comparison between the ray figure of the 0-Gr. in the Aalbæk B. in various years and the salinity of the bottom water at the Skaw Reef L. V. in Feb.—Mar.—Apr. of the same years.

0-Gr. in the Aalbæk B. in different years the annual variations of the mean number of rays are not quite inconsiderable. The idea suggests itself to examine whether a correspondence exists between these variations and the changes in the salinity of the bottom water (and, consequently, in the strength of the inward current) at the Skaw Reef L. V. These rather good correspondence in the run of the two graphs, the likeness being most conspicuous in the years in which the deviations from the mean figures are greatest. The following conclusions may be drawn from the graphs: that particularly large quantities of larvae are carried from the Skagerak into the Aalbæk Bay in the early spring of years

showing a comparatively strong inward current at the Skaw, or that larvae with a particularly high number of rays develop in such years, and *vice versa*, or, finally, that the higher salinity causes both a higher number of rays and an intensified influx of larvae. The coefficient of correlation for the two series of observation is $+ 0.456$ with $\sigma_r = 0.20$; this is another indication of a positive co-variation of salinity and number of rays.

For the purpose of deciding whether a co-variation of ray figure and salinity exists in areas where an immigration (influx) of larvae cannot greatly influence the ray figure I have used the Tannis Bay for a calculation of the correlation between ray figure (12 year-classes) and the bottom salinity at the Skaw Reef L. V. in February, March and April with the following result: $r = -0.197$, $\sigma_r = 0.27$; consequently, a distinct correlation between the two things cannot be established. This seems to indicate that the connexion between ray figures and salinity in the Aalbæk B. is the consequence of an influx of larvae from without, so that the salinity does not directly influence the ray figure.

The ray figure of the spawning fish is low in the northern Kattegat, and so it is obvious that the majority of these immigrated young fish leave the Kattegat again before the attainment of maturity. According to A. C. Johansen (l. c., 1910) the plaice of the northern Kattegat shows an annual growth of 8 cm. during its first 3 years of life; in the Aalbæk B. the lengths of the 0-Gr. and I-Gr. in October are 7—8 and 16—17 cm., respectively, the II-Gr. showing a length of 24—26 cm. (the investigations from 1904/06). Maturity begins at an age of three years (i. e. at the end of the II-Gr. stage). The subjoined analyses from the spawning season 1934/35 show that the majority of plaice become mature in the winter before they reach the age of 3 years.

	mature		immature	
I-Gr.	..	..	1	2
II-Gr.	8	74	11	24
III-Gr.	..	30	1	2
IV-Gr.	..	26	..	..

So we may take it that the bulk of the emigrating individuals leave at an age of $2^1/_2$—3 years, i. e. at a length of about 24—25 cm. or before they have reached minimum size limit. In other words the Kattegat fishery benefits only from a small part of the individuals that have immigrated or flowed in, viz. the fish that reach the minimum size limit before they emigrate on the beginning of the maturity, and from the (rather few) individuals that remain in the northern Kattegat until the beginning of maturity or still longer. A. C. Johansen (l. c., 1910) already called attention to the fact that the stock of mature plaice in the Kattegat consists of two groups: one group comprises small mature individuals of the "Belt Sea race", the other is made up of larger mature individuals of the "North Sea race". In the years 1903—07 he found the following ray figures for different size groups of mature plaice in the northern Kattegat:

15—24 cm.....	50.39 rays	51 ind.
25—34 -	53.68 -	78 -
35—37 -	55.20 -	5 -

A similar state of things appears when the ray figure is calculated for the different age groups as in the subjoined table, which is based on the investigations of the years 1935/36. The table includes individuals of the maturity stages IV—VII:

Gr.	No. of rays	No. of ind.
II.....	52.15	81
III.....	52.57	30
IV-VII.....	53.74	23

It seems to appear from these tables that the stock of mature plaice in the northern Kattegat is composed of two groups: young Baltic and older North Sea plaice. During the maturation of sperm and eggs part of the North Sea plaice emigrate, which appears from the fact that individuals of maturity IV and V show a higher ray figure than those belonging to the VI—VII-Gr.: the analyses of the years 1935/36 give the following mean numbers of rays for the different stages of maturity:

Mat. IV—V	52.96 rays	(101 ind.)
Mat. VI—VII.....	51.48 —	(33 —)

So it is evident that an extensive emigration of plaice of the North Sea race takes place from the northern Kattegat in proportion as the individuals of this race become mature at an age of 3 or 4 years; but a minor part of the North Sea stock remain and spawn here together with individuals of the "Baltic" race. The majority of the young fish of the 0-, I- and II-Gr. that occur densely in the Aalbæk B. migrate from the Kattegat out into the Skagerak either before or shortly after they have

reached the minimum size limit; only the lesser part of them disperse over the Kattegat. In other words the Aalbæk B. serves as a nursery ground for the marketable plaice both in the northern Kattegat and the Skagerak, and it is therefore doubly important that the population of young fish in the Aalbæk B. should be radically protected. Such a protection could be secured partly by a raising of the minimum size limit, partly by further restrictions to the fishery on the nursery grounds in the Aalbæk B., and the region between Hirsholmene and Hals.

b. The region Frederikshavn—Hals.

In most years the majority of the young fish in the northernmost part of the Kattegat, N. of Frederikshavn, are North Sea fish, but in the coastal area between Frederikshavn and Hals (K_2 and K_3) the young fish show a rather pronounced admixture of plaice of Baltic race (cp. Tables VI a and b), indeed, in some few years the stock is found to be almost of pure "Baltic" origin. The fall in the number of anal fin rays inside this area appears from the figures below, which represent the means of the individual coastal regions for the years 1928—38 collectively.

	0-Gr.	I-Gr.[1])	I-Gr.[2])
K_1 = the Skaw—Frederikshavn	54.05 (2 942 ind.)	53.92 (1 165 ind.)	53.88 (649 ind.)
K_2 = Frederikshavn—Stensnæs	53.75 (1 826 —)	53.63 (705 —)	52.93 (256 —)
K_3 = Stensnæs—Hals	52.91 (483 —)	52.78 (246 —)	..

Inside this coastal area the fall of the ray figure is a little above 1 both in the 0- and the I-Gr. The region Frederikshavn—Stensnæs is but little (about 0.3) below the Aalbæk B.; the deepest fall (about 0.8) occurs S. of Stensnæs. This state of things seems quite reasonable when we consider the conditions of depth. The deep channel that intersects the Kattegat W. of Læsø ends off Stensnæs, and the coastal region between Frederikshavn and Stensnæs lies in the immediate vicinity of this channel, so that it is comparatively open to an influx of larvae and young fish from the northern Kattegat and the Skagerak. The area S. of Stensnæs, however, is situated S. of this channel behind a large shallow area without any deep-water currents.

Of the individual year-classes within these areas we have the following analyses giving the numbers of anal fin rays of the 0-Gr.:

Year-class	K_2	K_3
1905	52.65 (220)	..
1906	50.09 (375)	..
1907	51.92 (25)	..
1924	54.26 (298)	53.11 (257)
1927	54.24 (67)	52.76 (33)
1928	52.78 (59)	53.42 (33)
1929	53.94 (106)	54.00 (84)
1930	53.54 (13)	51.67 (15)
1931	53.08 (106)	53.88 (24)
1932	54.77 (179)	54.38 (26)
1933	53.57 (237)	53.19 (72)
1934	54.07 (247)	51.51 (74)
1935	53.67 (538)	52.44 (55)
1936	53.59 (29)	53.76 (13)
1937	53.24 (152)	51.00 (4)
1938	53.87 (160)	52.57 (83)

As will be seen from the survey the variation of the year-classes may be rather great, the figures ranging between 50.09 and 54.77 in Area K_2, that is to say between a "pure Baltic stock" and nearly a "pure North Sea stock". The variation inside these two areas is considerably greater than in the region between the Skaw and Frederikshavn; as far as the 0-Gr. is concerned the variation of the year-classes 1927—38 has been examined in all 3 areas and shows the following figures:

K_1 = the Skaw—Frederikshavn	1.6 rays
K_2 = Frederikshavn—Stensnæs	2.0 -
K_3 = Stensnæs—Hals	2.8 -

Evidently, the influx of fry from the Skagerak is not so regular in the coastal area S. of Frederikshavn as in the Aalbæk B., indeed, in certain years it fails completely, as for instance in 1906 when the quantities of fry entering the Aalbæk B. from without were extremely small. However, in K_2 and K_3 as in K_1 the 1932 year-class has a very high ray figure.

A comparison of the bottom water salinity at Læsø Rende L. V. with the ray figure for the region Frederikshavn—Hals shows a co-variation similar to that found for the region the Skaw—Frederikshavn.

[1]) Coastal investigations.
[2]) Fishings with the eel-seine 1935—38.

c. The coastal area Hals—Gjerrild (the Aalborg B.).

This coastal area is situated far away from the deeper channels of the Kattegat and behind broad shallows. This goes well with the fact that the ray figures are particularly low here as will appear from the following mean values of the 0-Gr. and the I-Gr. for the years between 1928 and 1938.

	0-Gr.[1])	I-Gr.[1])	I-Gr.[2])
K_4 = Hals—Udbyhøj	51.34 (276)	51.75 (173)	51.13 (400)
K_5 = Udbyhøj—Gjerrild	50.95 (854)	50.90 (180)	..

In the area Udbyhøj—Gjerrild the ray figure is thus about 2.0 lower than between Stensnæs and Hals, and the values are as low as in many localities of the Belt Sea. Obviously, the influx of fry into this area (the Aalborg B.) from the northern Kattegat and the Skagerak is very limited, nor do we find so great a difference in ray figure between young fish and spawning fish as farther northwards (the Aalbæk B.). The ray figure of the spawning fish is 50.48 (89 ind.) or little lower than in the young fish of the region Udbyhøj—Gjerrild. So we may say that the greater part of the fry growing up in the inner parts of the Aalborg B. originate from the spawning places in the adjacent regions of the Kattegat or have come in from spawning places situated towards the south.

d. The southernmost part of the Kattegat.

Unlike the coast of the Aalborg B. the coastal regions of this area (the eastern coast of Jutland from Gjerrild to Hasenøre (K_6) and the northern coast of Seeland between Gniben and Gilbjerghoved (K_7)) are situated near deep water. The deep eastern Kattegat continues as a deep water basin down very close on the northern coast of Seeland branching off in deep channels among the shallows of the southwestern Kattegat and along the eastern coast of Jutland. Accordingly, the coastal areas in question are much more closely connected with the deep eastern Kattegat than is the coast of the Aalborg B., that is to say with the currents of the basins and channels leading from the Skagerak into the inner Danish waters.

In accord with this fact the ray figure of the young fish is much higher in these coastal areas than in the Aalborg B.:

	0-Gr. (1928—38)	I-Gr. (1928—38)
K_6 = Gjerrild—Hasenøre	51.22 (878)	51.05 (60)
K_7 = Gniben—Gilbjerghoved	52.07 (527)	53.02 (47)

Thus the mean figures of the areas Gjerrild—Hasenøre and Gniben—Gilbjerghoved are respectively 0.3 and 1.1 higher than those of the Gjerrild—Udbyhøj Area in the case of the 0-Gr. and 0.2 and 2.1 higher in the case of the I-Gr.

If we compare these ray figures with the figures of spawning fish in the regions E. of Djursland and N. of Sjællands Odde, that is to say off the coastal areas K_{6+7}, we find the following differences:

Spawning fish: 50.21 (133 ind.) against Gjerrild—Hasenøre, 0-Gr. 51.22, difference: 1, and against Gniben—Gilbjerghoved, 0-Gr. 52.07, difference: 1.9; in the Aalborg B. the corresponding difference was

Summary 6.

Year-class	0-Gr.			I-Gr.			0 + I-Gr.
	K_6	K_7	K_{6+7}	K_6	K_7	K_{6+7}	K_{6+7}
1906	..	50.00 (167)	50.00 (167)	..	..	..	50.00 (167)
1924	50.95 (21)	52.13 (54)	51.80 (75)	..	..	..	51.80 (75)
1927	50.89 (76)	..	50.89 (76)	..	..	..	50.89 (76)
1928	..	..	..	52.33 (9)	53.36 (25)	53.09 (34)	53.09 (34)
1929	52.67 (3)	52.00 (3)	52.34 (6)	..	..	..	52.34 (6)
1930	51.00 (10)	50.50 (8)	50.78 (18)	51.00 (15)	52.17 (6)	51.33 (21)	51.08 (39)
1931	..	50.50 (2)	50.50 (2)	..	53.00 (1)	53.00 (1)	51.33 (3)
1932	51.83 (52)	52.92 (62)	52.42 (114)	49.57 (14)	54.83 (6)	51.15 (20)	52.23 (134)
1933	51.23 (22)	53.73 (55)	53.02 (77)	51.00 (1)	..	51.00 (1)	52.99 (78)
1934	51.34 (288)	51.14 (14)	51.33 (302)	52.00 (1)	50.00 (7)	50.25 (8)	51.30 (310)
1935	51.13 (168)	51.08 (123)	51.11 (291)	51.50 (20)	51.33 (6)	51.46 (26)	51.14 (317)
1936	51.40 (15)	51.06 (35)	51.16 (50)	54.00 (1)	..	54.00 (1)	51.22 (51)
1937	51.61 (18)	53.03 (153)	52.88 (171)	..	..	..	52.88 (171)
1938	51.00 (302)	51.13 (72)	51.03 (374)	..	..	..	51.03 (374)
Variation (> 50 ind.)	0.9	3.7	3.0	..	..	..	3.0

[1]) Coastal nvestigations, Johansen's Young Fish Trawl. [2]) The eel-seine fishery, 1933—38.

only 0.5. Unlike the Aalborg B. the area dealt with here thus shows a conspicuous difference between young fish and spawning fish as regards the number of anal fin rays.

The mean numbers of rays for the 0- and I-Gr. of the individual year-classes are given in the subjoined table (No. of ind. in brackets) (see Summary 6, p. 23).

As will appear from the table the variation of the year-classes *inter se* is rather great (about 3.0). The idea suggests itself that this great variation from year to year must be due to a considerable influx of larvae from without into the southern (as into the northern) Kattegat and that the extent of this influx depends on the strength of the inflow of salt water from the north. Indeed we find a clear positive correlation between the salinity of the bottom water in the Kattegat and the number of anal fin rays.

With the salinity of the bottom water at the Skaw Reef L. V. in February—April the correlation is + 0.459 and σ_r 0.16. Between the ray figure and the bottom salinity (28 m.) at the Anholt Knob L. V. the following correlations have been calculated:

	r	σ_r
January	÷ 0.238	0.22
February	+ 0.233	0.22
March	+ 0.444	0.16
April	+ 0.435	0.16
May	+ 0.233	0.22

Thus a positive correlation exists from February to May, but it is only in March and April that the correlation is great enough and its mean error small enough to be of any importance; for these two months collectively the correlation is 0.461 and its mean error 0.16. So there is undoubtedly a distinct connexion between the salinity and the number of anal fin rays in the 0-Gr. stock of the same year, and in such a way that the ray figure is high when the salinity is high and *vice versa*; as stated above this seems to indicate that plaice larvae are carried into the southern Kattegat from the north and that this influx is particularly abundant in years showing a comparatively vigorous inflow of salt water.

The fact that the ray figure of the fry is generally about 1—2 higher than that of the spawning fish shows that the quantity of plaice carried into the southern Kattegat from the north is comparatively large and sufficient to influence the renovation of the plaice population of this water. On the basis of his investigations on the frequency of 0- and I-Gr. plaice along the coasts A. Fr. Bruun (1927) states that an immigration of 0-Gr. individuals takes place from the Skagerak into the northern Kattegat and that the effects of this immigration are also perceived in the southern Kattegat and the Belt Sea.

The Kattegat, Summary.

In Figure 6 are given the numbers of anal fin rays of the 0- and I-Gr. for the years 1928—38. It appears distinctly from the figure that there is a rapid fall of these numbers from the Aalbæk B. to the inner parts of the Aalborg B. and a rise from here to the southern and southeastern Kattegat.

In the figure a graph has been plotted stating the approximate distance (in naut. miles) of these coastal areas from the 30 m contour. It is noticed that the variation in the height of the ray figure follows the distance from the 30 m contour: the coastal areas (for instance K_{6+7}) lying near the deeper water have a comparatively high ray figure while those situated farther away from the deep water (for instance K_5) have a low ray figure.

Furthermore columns have been drawn in the figure showing the approximate ray figure of the spawning fish (provided that investigations to this effect are in hand). It is seen that the difference between the ray figures of young fish and spawning fish is great in areas situated near deeper water while it is small when there is a great distance to deeper water.

Finally, the figure shows that the ray figure of the young fish is higher than that of the spawning fish throughout the Kattegat.

All these observations indicate that the stock of plaice fry in the Kattegat does not only originate from the spawning places of this water; a great part of them arrive from spawning places in the Skagerak or the North Sea. This influx of fry from without urges itself in the northernmost region of the Kattegat where the great majority of fry observed originate from without. The extent and importance of this influx of fry decreases in a southerly direction along the eastern coast of Jutland; and in the inner areas of the Aalborg B., far away from the currents of the deeper parts of the Kattegat, it is of slight importance. In the southernmost Kattegat, which is situated near the deep areas and their currents, the influx of fry rises in extent. Thus the renovation of the plaice population in the Kattegat is to some

degree dependent on the appearance of fry in the waters outside the Skaw. As demonstrated above a considerable part of the fish that have entered the Kattegat as fry leave this water again; this

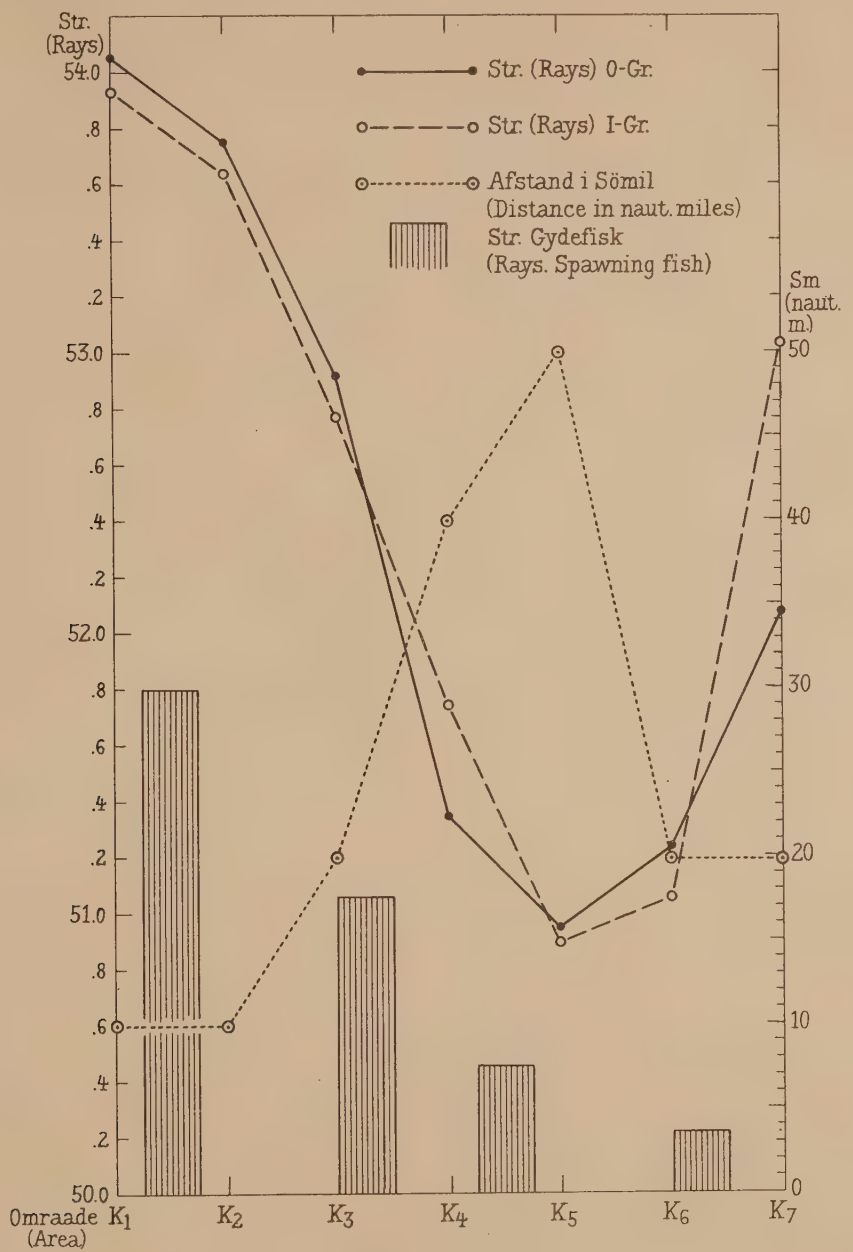

Fig. 6. The ray figure of 0-Gr., I-Gr. and spawning fish in various regions of the Kattegat compared to the approximate distance (in naut. miles) of the coast from the 30 m. contour.

this renovation is intensified in years that show a particularly vigorous inflow of salt water from the north into the Kattegat.

Upon their attainment of maturity, about the time at which they reach the minimum size limit, appears from the fact that the spawning fish possess a low number of rays as compared to the young fish.

Thus the rich nursery grounds of the Kattegat, particularly in the northernmost part, are important for the maintenance of the stock of marketable

plaice not only in the Kattegat but also in the waters outside the Skaw, principally the Skagerak.

The Sound.

In the Sound the number of anal fin rays in 0-Gr. plaice is still comparatively high although somewhat lower than in the southern but higher than in the western Kattegat. For the 3 areas of the Sound (see the map of Figure 10) the mean figures of rays of the 0-Gr. in the years between 1928 and 1938 are as follows:

	Ray figure	No. of ind.
$Ør_1$	51.69	150
$Ør_2$	51.09	941
$Ør_3$	51.12	217

In the northern district of the Sound, which is openly connected with the Kattegat, the ray figure is highest, higher than in the central and southern districts of the water. It is a surprising fact that the ray figure is so high in the southern part of the Sound (the Køge Bay); here—S. of the bar at Amager—Saltholm—one would expect the ray figure to be much lower. However, the height of the ray figure in this locality is due to the fact that one year-class (1928) with a high ray figure (52.03) was unusually rich in individuals: it makes up 114 of a total of 217 individuals examined.

The number of anal fin rays of spawning plaice (see Table I) in the Sound is 50.76 (344 ind.) or somewhat lower than that of the 0-Gr. However, this figure principally rests on investigations carried out in other years than those in which the rays of the 0-Gr. were found to have the following numbers of anal fin rays:

Year-class	$Ør_1$	$Ør_2$	$Ør_3$	$Ør_{1-3}$
1905	50.13 (31)	..	..	50.13 (31)
1906	50.01 (164)	49.92 (49)	..	49.99 (213)
1924	53.71 (83)	53.00 (2)	..	53.69 (85)
1925	..	..	50.38 (13)	50.38 (13)
1927	53.27 (11)	50.45 (22)	..	51.39 (33)
1928	48.71 (7)	49.17 (29)	52.03 (114)	50.96 (150)
1929	52.00 (2)	52.47 (15)	54.00 (1)	52.59 (18)
1930	50.87 (30)	51.55 (98)	51.00 (3)	51.38 (131)
1931	52.00 (2)	48.25 (8)	48.50 (2)	48.92 (12)
1932	52.06 (18)	51.44 (73)	50.69 (39)	51.37 (130)
1933	53.04 (23)	52.36 (100)	51.67 (3)	52.64 (126)
1934	52.00 (1)	51.09 (136)	50.75 (16)	51.00 (153)
1935	51.29 (17)	50.53 (402)	49.21 (14)	50.52 (433)
1936	51.31 (16)	50.59 (17)	51.50 (2)	50.93 (35)
1937	52.78 (9)	52.40 (5)	48.00 (1)	52.33 (15)
1938	50.68 (25)	51.07 (58)	50.05 (22)	50.76 (105)
Variation	3.70	2.44	..	3.70

Like in the southernmost part of the Kattegat the variation of the ray figure is rather great, 2—3 rays, the greatest difference being found next to the Kattegat, in $Ør_1$. Evidently, the Sound, too, obtains a share in the rather considerable influx of larvae from the Kattegat and, consequently, from the waters outside the Skaw. Between the ray figure of the 0-Gr. in the Sound ($Ør_{1-3}$) in the different years and the salinity of the bottom water (20 m.) at the Lappegrund L. V. (northernmost part of the Sound) in Feb.—Mar.—April of the same years the following correlation was found (the years 1924 & 29 were not included because no observations of salinity in February and March of these years are available):

$$r = + 0.536$$
$$\sigma_r = 0.19$$

Thus the correlation is positive and nearly thrice its mean error, which corroborates the idea of an influx of larvae from the north. If we look at the ray figures of the individual year-classes, we also see that some of them are very high, considerably higher than the highest ray figures observed in the spawning fish: the 1924 year-class in $Ør_1$ shows a ray figure of 53.71 (83 ind.), the 1928 year-class in $Ør_3$ 52.03 (114 ind.), the 1933 year-class in $Ør_2$ 52.36 (100 ind.). These ray figures cannot be explained in any other way than by an influx of larvae from the north. An influx from the south could not bring about so high ray figures: in the regions of the Baltic Proper that border on the Sound the ray figure never rises much above 51.5 and even in the waters round Bornholm and Rügen ray figures of more than 52 are rare. So it is obvious that the influx of larvae from the north into the Sound is of no small extent, in certain years (for instance in 1928) even in the southernmost part of the Sound, S. of the bar at Amager—Saltholm.

The Belt Sea.

An extensive material of analyses of the numbers of anal fin rays in plaice was worked by A. C. Johansen (l. c., 1928). In the case of the Great Belt A. C. Johansen found a rise in the number of anal fin rays from the period 1894—1907 to the period 1927—28 amounting to 1 ray; of this rise he says, "there is here no question of a permanent increase in the number of rays but only of a temporary increase", that is to say: an actual change in the

racial character of the plaice did not occur in this water. The comparatively high ray figure of 1927/28 can only be looked upon as a particularly distinct instance of the annual variation of the ray figure; similar high figures were also found in a few earlier years. He further demonstrates the close correspondence between the ray figure in the Belt Sea and the salinity of the surface water at the Schultz Grund and says about this, "This fact indicates either that the salinity of the water exerts directly or indirectly a certain influence on the number of the fin rays or that a relatively large number of larvae of the North Sea race are carried along with the southerly current into the Baltic waters in the years when the salinity of the water is comparatively high". The author further calls attention to the fact that the ray figure is highest in the coastal waters that border on the currents of the deep channels: "this indicates that considerable quantities of larvae of the North Sea race are carried from the Eastern Kattegat to the Belt Sea and the Baltic". Some interbreeding of the immigrated North Sea fish and the local Belt Sea fish takes place: A. C. Johansen mentions a sample of spawning fish from the northern part of the Great Belt ($^{29}/_{3}$ 28), which had a mean number of 51.34 rays; σ was only 2.2 or not so high (2.9) as it would have been if the sample had been the result of a mingling of $^{1}/_{3}$ North fish with $^{2}/_{3}$ Belt Sea fish.

50.3 and 51.0, apart from Smaalandshavet. In this water the ray figure is as low as 50.00 (240 ind.) or about $^{3}/_{4}$ lower than in the rest of the Belt Sea. Smaalandshavet is a rather isolated and quite shallow water while the rest of the Belt Sea is intersected by deep channels that constitute a continuation of the deep eastern Kattegat and lead in the currents from this water. The isolated character of Smaalandshavet may perhaps render it difficult for the larvae that have been carried into the Belt Sea by the current to enter this water, and this is possibly the cause of the low ray figure. For the rest the southern parts of the Belt Sea have a somewhat lower ray figure (the southern part of the Lesser Belt 50.31, the Langelands Belt 50.47) than its northern districts (50.67—50.95). The differences observed in the mean figures of the northern Belt Sea are small and of an incidental character; in most cases they are due to variations in the quantities of the individual year-classes inside the different areas: the area B_6 (southern Great Belt) shows a comparatively high ray figure, but this is because the 1938 year-class, which has a rather high ray figure, is particularly richly represented in the material from this area in comparison with the other year-classes.

A comparison for all year-classes collectively between spawning fish and 0-Gr. fish (cp. Table I and Table VI a) does not reveal any great differences as regards the ray figure (see Summary 7).

Summary 7.

	Spawning fish	0-Gr.	0-Gr. as compared to spawning fish
The Aarhus- and Sejrø B. (A)	50.90 (27 Ind.)	50.69 (1498 Ind.)	÷ 0.21
Northern Great Belt (C)	50.54 (563 —)	50.68 (1321 —)	÷ 0.14
S. of Samsø, N. of Funen (B)	50.69 (186 —)	50.81 (1965 —)	+ 0.12
South. Great Belt and the Langelands Belt (D)	50.39 (260 —)	50.71 (1000 —)	+ 0.32
Smaalandshavet (E)	49.94 (16 —)	50.00 (240 —)	+ 0.06
South. Lesser Belt (F)	51.02 (187 —)	50.31 (1285 —)	÷ 0.71

In the following we will use the larger material now available for a closer examination of the number of anal fin rays in the plaice of the Belt Sea and look into the annual variations of the ray figure and their causes, in order to see to what degree and in what way the plaice population of the Belt Sea is renewed from without.

The ray figures of the 0-Gr. plaice from various coastal areas in the years 1928—38 collectively are given on the map Figure 10, page 55.

On the whole the ray figure of the 0-Gr. is rather uniform all over the Belt Sea, ranging only between

Sometimes the ray figure of the 0-Gr. is a little lower, sometimes a little higher than that of the spawning fish. The data of the separate years give the following results when compared; No of individuals in ( ) (see Summary 8).

This comparison discloses certain rather considerable differences between the ray figures of spawning fish and 0-Gr. individuals. The most conspicuous difference is found in the southern part of the Lesser Belt. For all analyses collectively (cp. the preceding table) the ray figure of the spawning fish is 51.08 (164 ind.), that of the 0-Gr. only 50.31

Summary 8.

	Spawning fish	0-Gr. of corresp. summer	Difference (0-Gr. ÷ spawning fish)
Aarhus B.—Sejrø B. (B_1 og $_2$)			
Spawning season 1931—32	50.92 (24 Ind.)	51.24 (168 Ind.)	+ 0.32
— 1932—33	50.68 (31 —)	50.83 (47 —)	+ 0.15
— 1935—36	50.62 (29 —)	50.11 (83 —)	÷ 0.51
S. of Samsø, N. of Funen (B_3 og $_4$)			
Spawning season 1931—32	50.28 (43 —)	51.21 (842 —)	+ 0.93
— 1933—34	50.69 (49 —)	50.69 (412 —)	=
— 1937—38	50.75 (69 —)	50.88 (249 —)	+ 0.13
North. Great Belt (B_5)			
Spawning season 1902—03	50.03 (70 —)	50.33 (183 —)	+ 0.30
— 1923—24	50.22 (89 —)	50.36 (160 —)	+ 0.14
— 1927—28	51.37 (151 —)	50.91 (82 —)	÷ 0.46
— 1934—35	51.25 (20 —)	49.98 (133 —)	÷ 1.27
— 1935—36	50.44 (43 —)	50.54 (39 —)	+ 0.10
— 1937—38	50.02 (133 —)	50.92 (205 —)	+ 0.90
South. Great Belt—Langelandsbelt (B_6 og $_8$)			
Spawning season 1902—03	50.25 (40 —)	50.49 (263 —)	+ 0.24
— 1908—09	49.67 (52 —)	49.11 (28 —)	÷ 0.56
— 1929—30	50.16 (44 —)	51.21 (14 —)	+ 1.05
— 1935—36	50.74 (50 —)	50.01 (100 —)	÷ 0.73
— 1937—38	50.69 (46 —)	51.19 (244 —)	+ 0.50
South. Lesser Belt (B_9)			
Spawning season 1931—32	51.39 (28 —)	50.08 (128 —)	÷ 1.31
— 1934—35	51.06 (64 —)	50.53 (90 —)	÷ 0.53
— 1935—36	50.60 (20 —)	49.29 (69 —)	÷ 1.31
— 1937—38	51.36 (28 —)	50.61 (264 —)	÷ 0.75

(1 285 ind.): the ray figure of the 0-Gr. is 0.77 lower than that of the spawning fish. Furthermore, the account of the individual years shows that in the 4 years from which an interdependent material of spawning fish and 0-Gr. fish is in hand, the ray figure of the latter group is from 0.53 to 1.31 below that of the former. So we may venture to conclude that the fry found in the Lesser Belt does not originate exclusively from the stock of local spawners: a certain and not quite inconsiderable portion of fry must have been carried into this water from other areas, either from the north through the narrows of the Lesser Belt or from the south from the Western Baltic. It must be supposed that the influx takes place from the Western Baltic because the connexion between this water and the southern area of the Lesser Belt is much more open than the connexion from the north through the narrows at Strib and across the bar at Aarø. Another circumstance in favour of this supposition is the fact that the 0-Gr. has a lower ray figure in the Western Baltic than N. of Funen (50.25 against 50.87). In the southern part of the Lesser Belt, however, a certain number of 0-Gr. of "Leps"[1]) might be supposed to have been contained in the material examined: in the smaller bottom stages of the 0-Gr. the characteristic roughness of the "Leps" is not yet developed. An examination of 37 adult "Leps" caught in the southern part of the Lesser Belt in 1935—38 gave the following result as regards the number of anal fin rays:

No. of rays ...	42	43	44	45	46	47
No. of ind. ...	1	1	..	10	8	11
No. of rays ...	48	49	50	51	Mean:	46.41[2])
No. of ind. ...	1	2	2	1	37	

If a considerable number of "Leps" are found among individuals examined as 0-Gr. plaice, we may take it for granted that such an admixture will result in a comparatively numerous representation

[1]) "Leps" is the Danish term for the hybrid between *Pleuronectes platessa* and *Pl. flesus*.

[2]) From the years 1902—03 we have an analysis of 20 "Leps" from the Belt Sea + the Western Baltic; the mean of anal fin rays was 46.60. (Counted by A. C. Johansen).

of individuals with a ray figure of about 46. In Figure 7 the variation in the number of anal fin rays is graphically represented for 1 285 0-Gr. individuals caught in the southern area of the Lesser Belt between 1928 and 1938; if we compare this graph with that representing the 0-Gr. of the northern area of the Great Belt during the same period (1 321 ind.), we notice a slight bulge of the former against the ray figures 44—45—46 and 47, and this means that individuals showing these ray figures are a little too numerous in the former locality. For the said ray figures the difference between the two graps is

44 — 3
45 — 3
46 — 12
47 — 11

29 Mean number of rays 46.07.

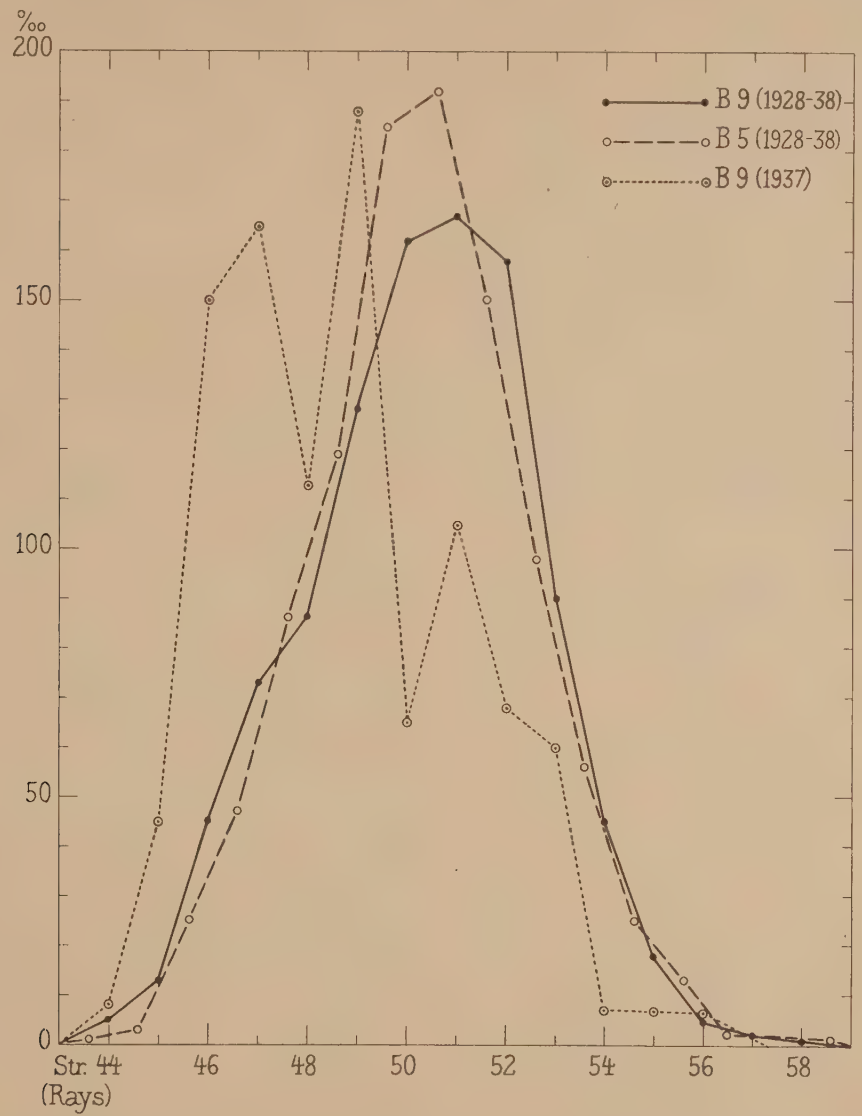

Fig. 7. Graphs representing the variation of the number of anal fin rays (calculated per 1 000 ind.) in 0-Gr. plaice from the southern part of the Lesser Belt (B_9) and the northern part of the Great Belt (B_5), year-classes 1928—38 and, for the former area, the 1937 year-class alone. The graph of B_5 has been plotted 0.4 ray to the left because its mean figure is 0.4 higher than that of B_9.

Thus the mean number of rays in these additional individuals is 46.07 or rather near the mean number of 46.41 found for the "Leps". So there is reason to believe that these additional individuals are expressive of the degree to which the material of 0-Gr. plaice from the Lesser Belt for the years 1928—38 is intermixed with "Leps". The graphs were based on a per mille calculation, and this means that the admixture of "Leps" amounts to 29 per mille or about 3 per cent.[1]). If we now calculate the average ray figure of the 0-Gr. deducting these 29 individuals, we get a mean of 50.41, or about 0.10 higher than the mean figure directly observed (50.31). In other words the difference is not very great, and even after this deduction the mean figure of the 0-Gr. is considerably lower than that of the spawning fish ($\div$ 0.67). However, the annual ray figures of the 0-Gr. (see Summary 9) in the Lesser Belt seem to indicate great variations from year to year in the quantity of 0-Gr. "Leps".

Summary 9.

Year	0-Gr. Rays	No. of ind.
1924	50.64	39
1927	51.30	30
1928	50.00	30
1929	49.34	32
1930	49.93	29
1931	48.67	3
1932	50.08	128
1933	50.12	59
1934	50.83	448
1935	50.53	90
1936	49.29	69
1937	48.75	133
1938	50.61	264

The annual variation of the ray figure is 1.94. A few years, 1937 and 1931 (?), are considerably below the ray figures that are otherwise found in plaice; so there is reason to believe that these particularly low mean numbers of rays are caused by an unusually numerous admixture of "Leps". The graph of Figure 7 represents the variation in the 0-Gr. of the 1937 year-class; the graph is very irregular and particularly remarkable by the great number of individuals with 46 and 47 rays; undoubtedly, a numerous admixture of "Leps" is found in this year[2]).

In the southern part of the Lesser Belt the ray figure of the 0-Gr. thus seems to be somewhat lower than that of the spawning fish, apparently on account of a certain influx of larvae from the Western Baltic; but in the rest of the Belt Sea conditions at large are different. A look at the table on page 28, which gives the ray figures of spawning fish and 0-Gr. fish in the corresponding summer, will show that the ray figures of the 0-Gr. are in most years a little higher than that of the spawning fish. The difference seems to be particularly great for the years 1932 and 1938 when the 0-Gr. surpasses the spawning fish by 0.32—0.93 and 0.10, 0.92 and 0.50 rays, respectively. In 1936, however, the 0-Gr. in most cases fails to reach the values of the spawning fish, the differences being $\div$ 0.51, $+$ 0.10 and $\div$ 0.73. This difference of ray figures seem to indicate a considerable influx, at any rate in certain years.

The idea of a rather considerable influx of larval plaice from the north into the Belt Sea in certain years is further corroborated by the fact that we know a series of reliable instances of an influx of larvae of other winter or spring spawners into the Belt Sea or the Western Baltic: in 1923 and 1929 larval haddock (A. C. Johansen, 1926 and Erik M. Poulsen, 1927); in 1923 and 1930 larval rough dab (Paul-Friedrich Mayer; Erik M. Poulsen, 1937); in 1932 larval coalfish (Erik M. Poulsen, 1937) and larval rough dab (Paul-Friedrich Mayer, 1937); in 1933 larval haddock (Erik M. Poulsen, 1937). These larvae, which do not normally occur in our inner waters, were carried in by marine currents, which must necessarily have carried in larval plaice, too, from the Kattegat. Altogether the years, in which a conspicuous influx of foreign larvae into the Belt Sea occurs, are indeed distinguished by high ray figures in the plaice fry of the northern Belt Sea. This will be seen from the subjoined survey of ray figures in plaice of the different year-classes within the period (1923—35) from which investigations on the influx of larvae are available; the years showing an extensive influx of foreign larvae are heavy typed:

[1]) In the Lesser Belt the numerical strength of the stock of "Leps" is about $^1/_{10}$ of that of the plaice population; in analyses of market plaice (in which "Leps" are included) from the years 1936—38 there were 503 plaice and 47 "Leps".

[2]) In this connexion it is interesting to look at a feature appearing from German investigations (C. Heinrici, 1938) in the Western Baltic: "Im Frühjahr 1937 war die Laichzeit (of the spring spawners flounder, plaice, common dab and cod) zeitlich stark zusammengedrängt". Thus in the spring of this year the spawning of plaice and "Leps" obviously coincided to a higher degree than is normally the case, so that the conditions of a hybridization of the two species of fish were particularly good.

Year	Rays in B_{1+5+6}
1923	51.00[1])
1924	50.29
1925	51.02
1926	50.70[1])
1927	50.82
1928	50.93
1929	51.85
1930	50.55
1931	49.62
1932	51.04
1933	51.03
1934	50.65
1935	50.04
Mean	50.79

Of the 5 years in which a numerous influx of foreign larvae was observed 4 have ray figures of 0.21—1.06 above mean and only one year is below mean (—0.24). In other words the high ray figures of the 0-Gr. plaice generally occur in the years in which an influx of foreign larvae into the Belt Sea is observed, and so there is reason to believe that these high ray figures are due to an influx of larval plaice from the north.

For the purpose of further examining the influx of larval plaice a comparison has been made between the number of anal fin rays in the 0-Gr. of different years and the inflow of salt water into the Belt Sea. The data used for this comparison are, on one hand, the ray figures of the consecutive years 1927—38 and the few years between 1902 and 1925 from which investigations are available, and from the coastal areas B_1, B_5 and B_6 (cp. the map Figure 10), that is to say the areas bordering on the currents of the channels through the Belt Sea, and on the other hand, the salinity of the bottom water at the Schultz Grund L. V. (northern entrance of the Belt Sea) between January and March, in which months the influx must mainly be supposed to take place. In the few cases when observations of salinity are lacking (because the L. V. had been removed on account of ice) the salinity of the month was calculated from the mean salinity of the previous and the following month; the salinities calculated in this way are given in brackets in the subjoined table:

[1]) From 1923 and 1926 we have no analyses of 0-Gr. fish; therefore the ray figures of these years were calculated on the basis of the older age groups of the year-classes (1923 242 ind., 1926 57 ind.), including analyses from the Great Belt and the westernmost part of the Western Baltic.

Year	A. Rays 0-Gr.	No. of ind.	Salinity ‰ Jan.	Febr.	March	April	May	Febr.-April
1902 ..	49.88	100	29.5	27.3	32.0	33.1	33.5	30.8
1903 ..	50.33	183	28.6	30.4	28.8	29.0	30.4	29.4
1905 ..	49.41	101	26.4	25.0	30.6	32.1	32.9	29.2
1906 ..	49.47	287	28.6	29.0	28.2	26.7	32.8	28.0
1924 ..	50.29	91	(31.1)	(31.1)	32.0	32.7	33.3	31.9
1925 ..	51.02	50	28.0	26.7	28.1	32.4	33.3	29.1
1927 ..	50.82	195	28.6	29.8	32.1	32.3	29.6	31.4
1928 ..	50.93	122	31.9	30.2	28.5	32.6	33.4	30.4
1929 ..	51.85	10	25.9	(33.1)	33.4	33.0	32.9	33.2
1930 ..	50.55	99	30.2	30.2	33.0	32.9	34.1	32.0
1931 ..	49.62	101	30.9	31.0	28.9	31.6	33.2	30.5
1932 ..	51.04	458	27.8	24.2	28.6	33.1	33.6	28.6
1933 ..	51.03	97	31.9	30.9	31.5	31.6	32.7	31.3
1934 ..	50.65	486	32.7	28.6	28.4	30.8	33.5	29.3
1935 ..	50.04	334	32.3	30.7	28.5	31.8	32.7	30.3
1936 ..	50.05	109	33.9	30.9	30.8	32.8	32.8	31.5
1937 ..	51.66	104	26.5	31.3	33.8	33.7	34.0	32.9
1938 ..	51.02	486	33.4	29.1	30.7	26.7	28.3	28.8

Mean of rays all years 50.54,
Mean Sal. ‰ Febr.—Apr. all years 30.5.

Between the number of anal fin rays and the salinity the following correlations were found for the individual months:

	r	σ_r
January	÷ 0.205	0.23
February	+ 0.277	0.22
March	+ 0.385	0.20
April	+ 0.272	0.22
May	÷ 0.064	0.24

Thus there is a positive correlation for the months of February, March and April, March showing the highest figure. For these three months collectively the correlation (r) is + 0.48 and its mean error (σ_r) 0.19: the coefficient of correlation is rather more than twice its mean error. In other words the material shows that the ray figure is mostly high in years with a particularly rapid inflow of salt water during the spring months, and *vice versa*, and this again means that the calculation of correlation corroborates the supposition advanced above, viz. that there is a rather considerable influx of plaice from the Kattegat to the Belt Sea.

When larval plaice are carried from the Kattegat into the northern Belt sea, one may expect to find a certain correspondence between the annual variations of the ray figure of the 0-Gr. in the southern Kattegat and the northern Belt Sea. The following survey shows the ray figures of the 0-Gr. in the

southern Kattegat (K_{6} & $_{7}$) and the northeastern Belt Sea ($B_{1, 5, 6}$):

Year-class	K_{6+7}	B_{1+5+6}
1906	50.00 (167)	49.47 (287)
1924	51.80 (75)	50.29 (91)
1927	50.89 (76)	50.82 (195)
1929	52.34 (6)	51.85 (10)
1930	50.78 (18)	50.55 (99)
1931	50.50 (2)	49.62 (101)
1932	52.42 (114)	51.04 (458)
1933	53.02 (77)	51.03 (97)
1934	51.33 (302)	50.65 (486)
1935	51.11 (291)	50.04 (334)
1936	51.16 (50)	50.05 (109)
1937	52.88 (171)	51.66 (104)
1938	51.03 (374)	51.02 (486)

As will be seen there is a rather close correspondence between the two series, the deviations from the mean number altogether showing the same tendencies in the two waters. The correlation between the two series is $+ 0.754$ and $\sigma_r = 0.12$.

On the previous pages has been stated that the variations of the ray figure depend on the quantity of larvae that flow in from the Kattegat in spring, which again means on the strength of the ingoing current. However, it might also be supposed that the variations in the ray figure were due to variations of the ray figure in the local stock of spawning fish, brought about by a more or less pronounced admixture of immigrating fish of the North Sea race taking part in the spawning. Such an admixture of spawning fish of the North Sea race would then be dependent on the inflow of salt water in the months immediately before the spawning season, either because a stronger inflow would carry more presently spawning fish of the North Sea race into the Belt Sea, or because it would make more of the North Sea plaice that had arrived as larvae or young fish remain in the Belt Sea and spawn there under the improved conditions. For the brief period 1924—27 Aage J. C. Jensen (1933) found a covariation between the ray figures of the said year-classes (both younger and older individuals) and the salinity of the bottom water at the Schultz Grund L. V. in the months of November and December previous to the spawning season. However, the larger material now in hand does not show such a correspondence. In the following table the number of anal fin rays of the 0-Gr. in the northeastern Belt Sea (Areas $B_{1, 5, 6}$) is compared to the salinity of the bottom water at the Schultz Grund in November and December of the previous year:

Year-class	A. fin rays	Sal. ‰
1902	49.88	30.3
1903	50.33	28.9
1905	49.41	31.6
1906	49.47	31.3
1924	50.29	26.1
1925	51.02	32.3
1927	50.82	31.0
1928	50.93	27.0
1929	51.85	29.8
1930	50.55	29.7
1931	49.62	28.8
1932	51.04	29.7
1933	51.03	31.2
1934	50.65	29.5
1935	50.04	29.6
1936	50.05	31.7
1937	51.66	30.3
1938	51.02	31.6

The correlation between the two series is -0.065 and $\sigma_r = 0.24$. So there is nothing here to show a dependence of the ray figure of the fry on the inflow of salt water in Nov.—Dec. of the previous year; neither does a comparison between the ray figures of spawning and 0-Gr. fish (see page 28) indicate such a dependence. In some cases there may be a rather considerable difference between the ray figures of spawning fish and 0-Gr. fish in the same year and the same area, which seems to indicate that the 0-Gr. stock of some years only to a certain degree originates from the local spawning; especially in the northern part of the Belt Sea the ray figure of the 0-Gr. may for instance be considerably higher than that of the spawning stock, and this can hardly be due to anything else than an influx of larvae from without.

As regards the influx of larval plaice from the Kattegat the following facts have now been established:

1. In the northern part of the Belt Sea the ray figure of the 0-Gr. is in certain years somewhat higher than that of the spawning fish.
2. There is a distinct positive correlation between the ray figure of the 0-Gr. and the inflow of salt water in the months of March—May.
3. There is a distinct positive correlation between the ray figures of the 0-Gr. in the southern Kattegat and the northern Belt Sea.

Item 1. shows that the 0-Gr. is not only recruited from the local stock of spawners, item 2. that the ray figure is high in years that offer favourable conditions for an influx of larval plaice from the north and, finally, it appears from item 3. that there are carried from the Kattegat to the Belt Sea by the marine current. Judging from the numbers of rays found in the fry this influx is rather extensive in some years, in others it is extremely scanty. However, the influx into the Belt Sea never reaches

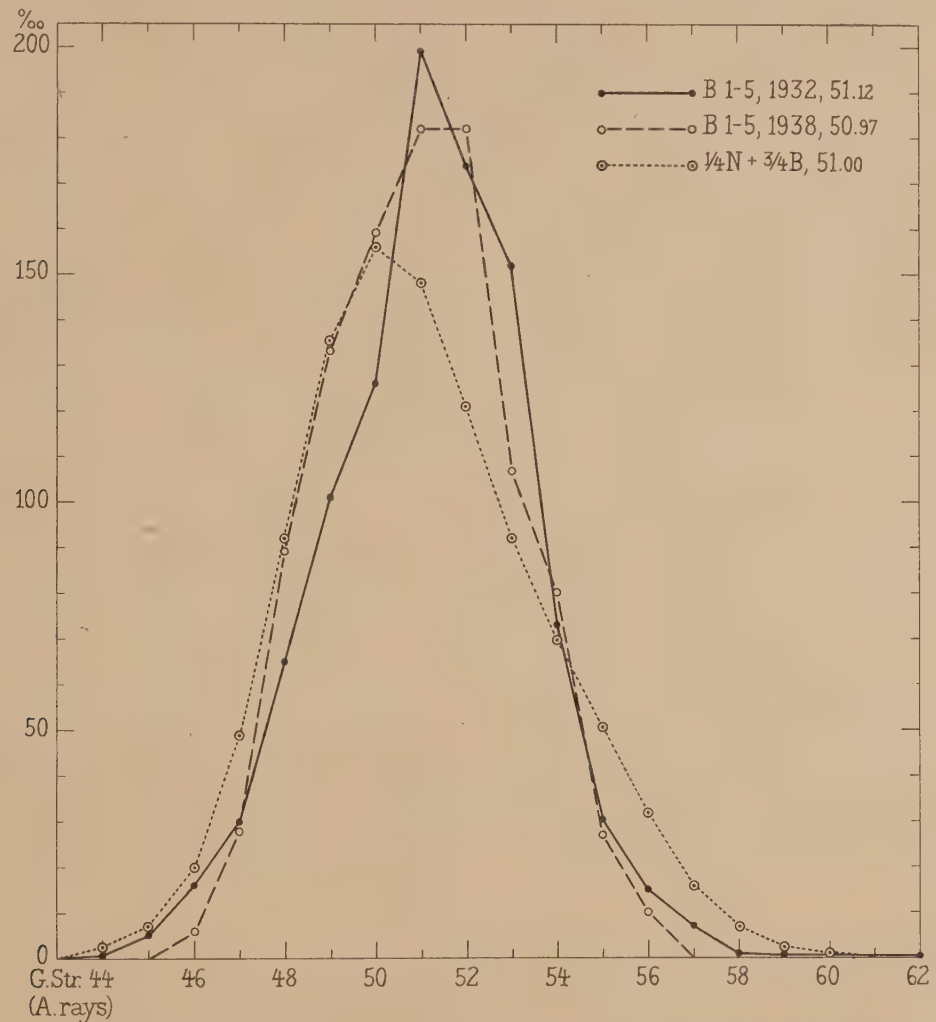

Fig. 8. Comparison between distributional graphs for 0-Gr. stocks in the Belt Sea and the distributional graph of a calculated stock with 51 rays ($^1/_4$ North Sea fish + $^3/_4$ Belt Sea fish).

is a certain connexion between the stocks of the Kattegat and the Belt Sea. Add to this that abundant quantities of larval stages of fish that do not spawn in the Belt Sea (haddock and coalfish) have in several cases been observed in this water, a proof that the marine current is able to carry and does carry eggs and larvae from the Kattegat into the Belt Sea: we may then take it for granted that considerable amounts of eggs and larvae of plaice such an extent and importance for the recuperation of the stock as the influx from the Skagerak into the northern Kattegat.

It is a natural consequence of the influx into the Belt Sea that the 0-Gr. of the Belt Sea plaice is a mixed stock consisting of a ground stock of Belt Sea fish intermixed with a certain quantity of fry arrived from the north; of course this fry consists partly of Belt Sea fish hatched in the Kattegat,

partly of fry of the North Sea race. In the Belt Sea we frequently find stocks of plaice with an average of 51 rays. Such stocks would then be produced by a mingling of Baltic plaice (from the Belt Sea or the southern Kattegat) with about 50 rays on one hand with plaice of the North Sea race (from the northern Kattegat or the waters outside the Skaw) with about 54 rays on the other. However, in basing his calculations on a number of plaice of different age groups from 1927—28 and with a mean number of 51 rays Aage J. C. Jensen (l. c., 1933) has demonstrated that the graph representing the distribution of ray figures in this sample does not possess the low apex or the flatness of the graph plotted for a calculated mixture of plaice of Baltic race and North Sea race in a proportion as to give the ray figure 51. Furthermore, by a calculation of "P" the said author points out that the two graphs are not uniform, and he thus arrives at the conclusion that there is but a diminutive chance of the ray figure 51 resulting from a mingling of fry of the two races and that the figure 51 must therefore be the result of an interbreeding of the two races. In the same way R. Kändler (1935) has shown that the plaice population of the Baltic (with ray figures of 51—52) cannot either originate from a mixing of the fry, and he further shows that the standard deviation is not so high (about 2.8) as it would have been in a mixed stock. The Belt Sea material from recent years fully corroborates the observations of Aage J. C. Jensen and R. Kändler as regards the normal shape of the distributional graph and the low standard deviation.

In Figure 8 we find the distributional graphs for 0-Gr. plaice in the Belt Sea with an average of about 51 rays (B_{1-5} 1932 1 302 ind., B_{1-5} 1938 674 ind.), and, for comparison's sake, the figure also shows the graph plotted by R. Kändler for a mixed stock with 51 rays. It appears distinctly from the figure that the distributional graphs of the 0-Gr. stock with about 51 rays do not coincide with the calculated graph: the former are higher and narrower and in shape comes rather near to the distributional graphs found for pure stocks or for stocks originating from a hybridization. The standard deviations found for the Belt Sea are also lower (c. 2.0—2.4) than one would expect to find them in a mixed stock and of the same size as or slightly higher than those found in pure stocks as will appear from the following survey of the standard deviations (σ) of different year-classes in the northern part of the Belt Sea (0-Gr.) and in the Horns Reef Area (older age groups):

	Year-cl.	Rays	No. of ind.	σ	m
The North. Belt Sea	1936	49.73	193	2.60	0.13
	1930	50.11	161	2.00	0.11
	1935	50.17	766	2.25	0.06
	1934	50.71	1173	2.09	0.04
	1928	50.80	139	2.17	0.13
	1938	50.97	674	2.02	0.06
	1932	51.22	1302	2.21	0.04
	1937	51.26	162	2.62	0.15
The Horns Reef area	1928	53.81	404	2.14	0.11
	1930	54.03	214	2.23	0.15
	1932	54.82	576	1.91	0.08
	1934	54.18	773	1.92	0.06
	1935	54.12	683	1.98	0.07

Ta

Area	A.			B.		
Age-Gr.	0	I	II	0	I	II
Year-class						
1927	50.91 (179)	..	51.02 (57)	50.85 (247)	50.60 (52)	51.03 (40
1928	..	49.00 (4)	51.67 (3)	50.56 (57)	50.56 (62)	50.17 (6
1929	..	50.50 (1)	51.38 (107)	52.10 (10)	50.73 (33)	51.37 (65
1930	50.00 (3)	51.00 (33)	51.12 (102)	49.71 (69)	50.64 (25)	50.44 (105
1931	..	50.18 (11)	50.76 (90)	49.20 (5)	49.00 (3)	50.69 (19
1932	51.52 (116)	51.29 (101)	51.35 (86)	51.28 (842)	51.36 (36)	51.58 (36
1933	49.63 (19)	51.08 (12)	52.07 (15)	51.19 (48)	50.00 (1)	..
1934	50.62 (288)	50.79 (63)	50.60 (44)	50.69 (412)	50.83 (42)	50.96 (57
1935	50.18 (313)	50.96 (122)	50.64 (139)	50.27 (172)	50.71 (49)	50.38 (126
1936	50.11 (83)	50.00 (4)	50.76 (55)	48.85 (71)	49.91 (12)	49.00 (2
1937	51.47 (89)	52.70 (237)	..	50.50 (36)	51.16 (25)	..
Mean...	50.81 (6)	51.43 (4)	50.96 (8)	50.43 (8)	50.68 (4)	50.84 (5

This discrepancy of the standard deviations and the incongruity of the observed graphs and the calculated graphs of mixture are looked upon by Aage J. C. Jensen and R. Kändler as a proof that the stocks in question are not mixed stocks, but this view is perhaps not quite well-founded. There seems to be a rather dubious justification in supposing that a mixed stock occurring in the Belt Sea (or the Baltic) must necessarily show a distributional graph that corresponds to that of a mixture calculated mathematically; we must not then and there infer that the mixing of two races takes place in the same simple way in the Belt Sea as on a piece of paper. Conditions of various kinds that have not been considered in the calculated mixture may come to influence a mixing that takes place in nature. We know that a series of racial characters: ray figures, keeled scales, and vertebrae, vary in the same way, in a positive correlation with each other; so there is reason to believe, or at any rate we cannot discount the possibility that other racial characters, such as qualities of a physiological kind, may vary in the same way and the same direction; so that for instance in a stock of larval North Sea plaice the individuals possessing the high ray figure of the North Sea race in a pronounced degree are the least tolerant of a lesser salinity, or in other words that the specimens showing a +-deviation from the ray figure also show a +-deviation as regards the optimum of salinity. When a number of larvae of the North Sea race enter the less salt water of the Belt Sea, a certain selection will result from the mortality being highest in individuals with a high number of rays. However, this very fact involves that, apart from the normal mortality, a certain number of individuals with a comparatively high ray figure perish in the mixed stock, so that we get "too few" individuals in the right-hand part of the distributional graph. Therefore the graph will be less flat than it ought to be, so that it does not correspond to the distributional graph calculated for the mixed stock, but approaches the appearance of the graph of an unmixed stock. If we now compare the variation of the ray figures in the 1932 0-Gr. of the northern Belt Sea with a mean number of rays 51.2 with Kändler's calculated mixture of $^3/_4$ of Belt Sea fish and $^1/_4$ of North Sea fish and with a stock of the same mixture, but corrected from the supposition of a higher mortality among the +-variants in the influx of North Sea larvae (from the value 53 rays were deducted 20 per cent., from 54 40 per cent., from 55 60 per cent., from 56 80 per cent., and from 57 100 per cent.), we find a good correspondence between the graphs illustrating the variation of the corrected stock and of the 1932 0-Gr. For the stock of 0-Gr. fish $\sigma = 2.3$, for the direct mixture 2.6, and for the corrected mixture 2.3, and so the σ of the 0-Gr. is in accord with that of the corrected mixture.

It is therefore possible that the graph that illustrates the variation of the ray figure in the Belt Sea represents a mixed stock though it does not correspond with a graph representing a direct mixture as far as shape and σ is concerned. The fact that the distributional graphs observed in the Belt Sea do not coincide with the graph of the

	C		D			F		
0	I	II	0	I	II	0	I	II
77 (185)	51.60 (48)	51.45 (137)	50.74 (19)	51.39 (26)	49.00 (1)	50.73 (37)	50.20 (10)	50.97 (31)
91 (82)	50.96 (51)	..	50.77 (101)	49.92 (12)	49.25 (4)	50.00 (30)	50.14 (7)	50.00 (1)
78 (9)	49.25 (4)	50.59 (80)	49.89 (9)	50.00 (4)	..	49.34 (32)	48.50 (2)	50.70 (82)
43 (89)	50.80 (79)	50.73 (141)	51.00 (27)	52.00 (5)	50.74 (27)	49.93 (29)	50.43 (7)	50.68 (31)
62 (101)	49.98 (45)	50.99 (86)	50.30 (10)	49.97 (37)	50.17 (90)	48.67 (3)	50.45 (11)	50.71 (31)
00 (344)	51.00 (11)	51.46 (173)	51.18 (192)	51.23 (22)	..	50.08 (128)	50.84 (48)	50.95 (58)
64 (28)	51.70 (20)	50.92 (89)	50.84 (97)	..	50.28 (29)	50.12 (59)	49.95 (19)	51.11 (28)
29 (376)	50.53 (90)	51.30 (45)	50.71 (24)	49.79 (19)	50.68 (92)	50.83 (448)	50.67 (82)	50.42 (97)
98 (133)	50.69 (61)	50.41 (126)	50.20 (119)	50.48 (67)	50.80 (51)	50.53 (90)	50.28 (47)	50.67 (69)
54 (39)	51.27 (30)	50.33 (30)	50.00 (100)	50.22 (9)	50.13 (30)	49.29 (69)	50.33 (9)	50.18 (34)
51 (37)	50.83 (71)	..	50.71 (70)	50.35 (26)	..	48.75 (133)	50.51 (65)	..
43 (7)	50.75 (7)	50.98 (8)	50.62 (6)	50.48 (1)	50.56 (3)	49.93 (6)	50.58 (4)	50.66 (4)

calculated mixture cannot then and there be taken as a proof that the Belt Sea stock is no mixed stock. Furthermore, several biological facts directly observed (see page 32) suggest that the 0-Gr. of the Belt Sea is more or less intermixed with plaice of the North Sea race, and altogether this must make a better proof than the lack of correspondence between the distributional graphs observed and the graphs that are calculated directly on the paper but not corrected.

On the preceding pages the ray figure of the 0-Gr. was dealt with, and comparisons were made between the ray figures of the 0-Gr. fish and spawning fish. In the following the ray figures of the I- and II-Gr. will also be included in the comparison.

Our observations concerning the ray figures of the I- and II-Gr. originate from 3 different sources: coastal fishings with Johansen's Young Fish Trawl, the eel-seine fishings from the research vessel of the Biological Station, and the catches of the commercial fishery. The results of these analyses are given in Table VII where the material is arranged by areas for the different year-classes. The I- and II-Gr. individuals examined are in some cases rather few in number, and the first comparison of the different series of analysis gives rather a chequered picture, obviously beset with comparatively great errors. In most cases, however, the ray figures of the I- and II-Gr. are higher than those of the 0-Gr.; the opposite is rarely the case. The table 4 p. 34—35 gives the material in a comprehensive form and for each separate water. As the number of individuals from Smaalandshavet (Area E) are mostly small, this water is not considered in the table. The quantities of individuals examined are given in brackets.

For each age group inside the individual areas the bottom column of this table states the mean number of anal fin rays in all analyses resting on more than 40 individuals. Here we see that in all areas with the exception of Area D (where the number of results of analysis—given in brackets—is only one) there is a rise of the ray figure from the 0-Gr. through the I-Gr. to the II-Gr. The rise from the 0- to the I-Gr. and from the I- to the II-Gr. is as follows:

	I-Gr. ÷ 0-Gr.	II-Gr. ÷ I-Gr.	II-Gr. ÷ 0-Gr.
A.	+ 0.62	÷ 0.47	+ 0.15
B.	+ 0.25	+ 0.16	+ 0.41
C.	+ 0.32	+ 0.23	+ 0.48
D.	÷ 0.14	+ 0.08	÷ 0.06
F.	+ 0.65	+ 0.08	+ 0.73

Altogether the ray figure of the I-Gr. is rather higher than that of the 0-Gr., and the II-Gr. again is somewhat above the I-Gr. A contemplation of the separate year-classes gives the same result; in Figure 9 the following mean figures for the 0-, I- and II-Gr. of the different year-classes in Areas A, B, C and D (numbers of individuals in brackets) are used for a graphical representation of the variations in the ray figures of the 0-, I- and II-Gr. of the same year-classes within the different areas.

Year-class	0-Gr.	I-Gr.	II-Gr.
1927	50.84 (630)	51.15 (128)	51.26 (235)
1928	50.77 (240)	50.61 (129)	50.23 (13)
1929	50.96 (28)	50.50 (42)	51.13 (252)
1930	50.24 (188)	50.86 (142)	50.75 (375)
1931	49.66 (116)	49.97 (96)	50.63 (282)
1932	51.21 (1494)	51.28 (170)	51.44 (295)
1933	51.02 (220)	51.42 (33)	50.91 (133)
1934	50.57 (1225)	50.60 (214)	50.78 (338)
1935	50.00 (885)	50.74 (299)	50.52 (442)
1936	49.79 (293)	50.71 (55)	50.50 (117)
1937	51.10 (232)	52.00 (359)	..

It appears distinctly from the graph that a rise of the ray figure from 0- to I-Gr. is the usual thing; however, from I- to II-Gr. there is now a rise and now a fall in the number of rays. For the separate year-classes the rise from 0- to I-Gr. and from 0- to II-Gr. is illustrated by the following figures:

	I-Gr. ÷ 0-Gr.	II-Gr. ÷ 0-Gr.
1927	+ 0.31	+ 0.42
1928	÷ 0.16	÷ 0.54
1929	÷ 0.46	+ 0.17
1930	+ 0.62	+ 0.51
1931	+ 0.31	+ 0.97
1932	+ 0.07	+ 0.23
1933	+ 0.40	÷ 0.11
1934	+ 0.03	+ 0.21
1935	+ 0.74	+ 0.52
1936	+ 0.92	+ 0.71
1937	+ 0.90	..

These observations of a rise of the ray figure go to show that an immigration of young fish from the Kattegat into the Belt Sea, more particularly its northern area, takes place in certain cases. In the southern part of the Lesser Belt the rise is possibly caused by a re-emigration of fish (with a low number of rays) that had been carried into this water from the Western Baltic as larvae, or it is due to the mere fact that the 0-Gr. material contains a small number of "Leps" (see page 28), which is not the case with the I- and II-Gr., in which the se-

paration of the "Leps" is complete. As mentioned on page 27 the ray figure of the spawning fish is altogether lower than that of the 0-Gr. fish, which again means that a considerable portion of the plaice that have been carried in as larvae or have immigrated as young fish leave again before spawning. As regards this emigration before spawning the fish that have arrived as fry (through influx or immigration) accordingly behave in the same way as the majority of the North Sea plaice transplanted to the Belt Sea (cp. page 41). In this connexion it is interesting to note that the haddock flowing into the Belt Sea as fry in 1923 left again before spawning (A. C. Johansen, 1925).

A comparison by year-classes of the material of Table VII with the 0-Gr. material from the whole Belt Sea in 1934 (see Table 5) gives the average ray figures for the individual year-classes.

The mean number of rays for all year-classes 1927—38 is 50.72 ± 0.02.

The Western Baltic.

The Western Baltic, more particularly the westernmost area between Langeland and Als, is openly and directly connected with the southern part of the Belt Sea, and therefore there is no great difference as regards the number of anal fin rays between the stocks of the two waters, as will appear from the subjoined survey of ray figures in the 0-Gr.:

	M. of rays	No. of ind.	year-class
V $Ø_1$ (Broager—Gulstav)	50.25	592	1928—38
V $Ø_2$ (Kappel—Gedser) .	49.67	57	1934—37
Southern Lesser Belt ...	50.31	1285	1928—38
Langelands Belt	50.47	413	1928—38
Smaalandshavet	50.00	240	1928—38

Thus the ray figure of the western area of the Western Baltic is very nearly the same as that found in the southern part of the Lesser Belt; but in the eastern area (S. of Lolland) the ray figure seems to be comparatively low, the difference being well over $^1/_2$ ray. However, the material from the eastern area is small and the mean figure therefore not very reliable.

The ray figures given above differ but little from R. Kändler's (l. c.) ray figures for plaice of dif-

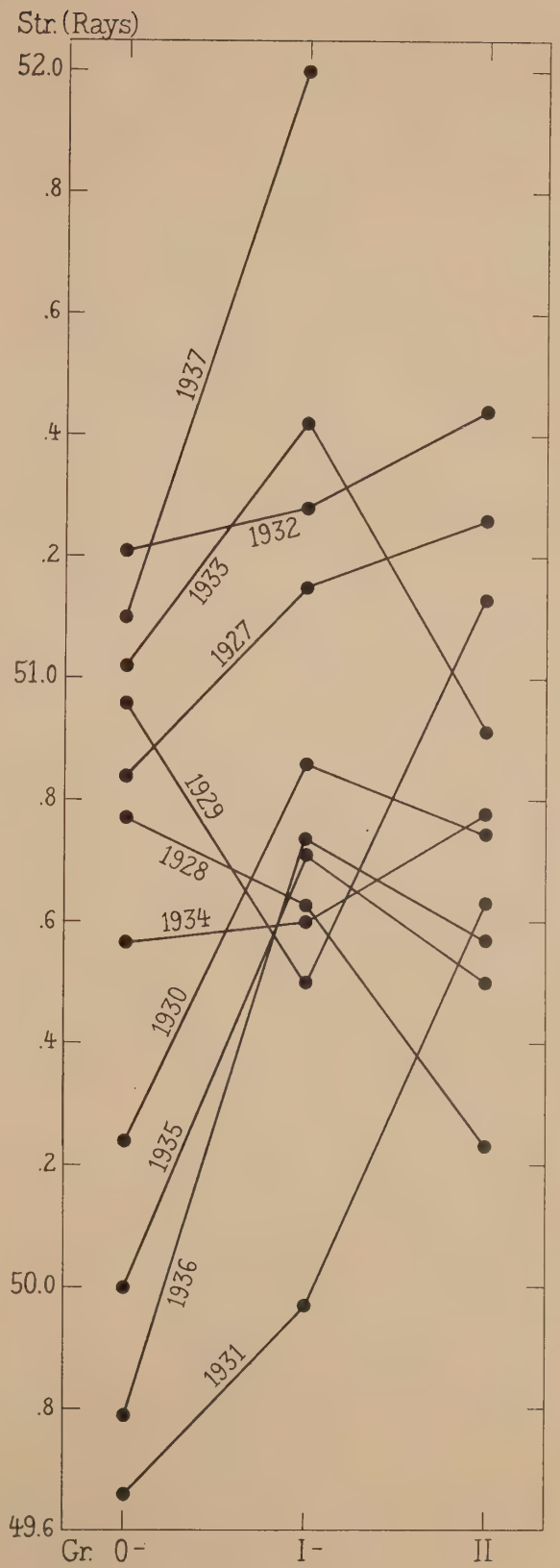

Fig. 9. Mean numbers of rays in 0-, I- and II-Gr. fish of different year-classes in Areas A, B, C and D of the Belt Sea; from the Table in the text of page 35.

Table 5.

Year-class	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	Total
43	1	..	..	..	..	..	..	..	..	..	1	..	2
44	3	1	2	2	3	1	..	4	3	1	1	1	22
45	5	5	3	1	5	8	1	9	21	13	8	..	79
46	20	6	6	13	21	43	7	38	73	42	31	13	315
47	46	19	19	39	39	74	20	97	118	52	53	44	620
48	70	45	30	87	53	129	33	194	204	59	60	103	1067
49	135	64	57	118	78	232	68	307	256	80	70	168	1633
50	186	92	73	157	101	328	74	448	341	83	99	204	2186
51	188	76	84	166	102	438	100	469	387	89	119	231	2449
52	161	58	73	129	87	400	72	351	270	77	100	238	2016
53	145	52	42	71	49	317	38	221	159	46	94	150	1384
54	77	32	29	37	25	163	29	117	91	28	73	85	786
55	43	6	12	22	11	78	15	38	46	10	39	28	348
56	13	4	7	6	4	29	4	18	12	3	27	14	141
57	3	1	1	3	..	12	4	8	..	2	12	1	47
58	1	1	1	1	..	3	..	2	..	..	4	..	13
59	..	1	..	1	..	1	1	1	..	1	..	..	6
60	..	..	..	..	..	..	..	..	..	..	..	..	..
61	..	..	..	..	..	..	..	..	..	..	..	..	..
62	..	..	..	..	..	1	..	..	..	..	..	..	1
Total	1097	463	439	853	578	2257	466	2322	1981	586	791	1280	13113
Mean	51.06	50.62	50.83	50.58	50.30	51.15	50.83	50.63	50.32	50.02	51.06	50.91	50.72
σ	..	..	..	..	..	..	..	..	..	..	..	..	2.24
m	..	..	..	..	..	..	..	..	..	..	..	..	0.02

ferent age groups: western area of the Western Baltic 50.78 ± 0.12, eastern area of the same water 50.21 ± 0.09; here, too, the ray figure is somewhat lower in the eastern than in the western area.

The ray figures of the 0-Gr. of the Western Baltic in the separate years seem to indicate rather considerable fluctuations from year to year. The Summary 10 gives the ray figures of the 0-Gr. in the two coastal areas V $Ø_1$ and V $Ø_2$ in the years 1922, 1924 and 1927—38, numbers of individuals in brackets.

Summary 10.

Year-class	V$Ø_1$	V$Ø_2$
1922	49.87 (8)	..
1924	50.57 (14)	..
1927	50.50 (30)	..
1928	49.79 (14)	..
1929	45.00 (1)	..
1930	49.00 (3)	..
1931	48.67 (3)	..
1932	49.25 (28)	..
1933	49.57 (42)	..
1934	50.65 (396)	50.57 (14)
1935	48.56 (18)	49.41 (34)
1936	49.36 (33)	49.25 (4)
1937	48.81 (31)	49.20 (5)
1938	51.22 (23)	..

1934 is the only year from which we have a really comprehensive analysis from Area V $Ø_1$: M = 50.65 (396 ind.). This ray figure is nearly as high as that of the Belt Sea in the same year. In the rest of the years the analyses include rather few individuals, but the fact that most of the mean figures observed are low shows that the ray figure is generally lower in the Western Baltic than in the Belt Sea. The number of I-Gr. individuals examined is so small that no comparison can be made between the ray figures of 0- and I-Gr.

For the purpose of getting a comprehensive view of the fluctuations of the ray figure from one year-class to another the number of anal fin rays for each year-class of the period between 1916 and 1938 have been arranged in Table VIII (page 79), on the basis of analyses of the different age groups. When we consider such year-classes only of which more than 100 individuals were examined, the ray figure is found to range between 49.91 and 51.07, i. e. a variation of 1.2 ray. The lowest mean figure observed is 48.94 (35 ind.) for the 1937 year-class; however, this mean figure is principally based on the 0-Gr. (31 ind.), which evidently contained a few "Leps" (as already mentioned on page 30 there was an abundance of "Leps" fry in 1937). The lowest ray figure basing on adult individuals (III-Gr.) is that of the 1918 year-class: 49.95 (43 ind.).

A comparison between analyses (of more than 50 individuals) from the Belt Sea and from the Western Baltic between Langeland and Als gives the following results (No. of ind. in brackets):

Year-class	The Belt Sea	West. part of the Western Baltic	B. S. minus W. B.
1927 II-Gr. . . .	51.24 (194)	50.90 (55)	+ 0.34
1934 0-Gr. . . .	50.61 (1524)	50.65 (396)	÷ 0.04
1935 II-Gr. . . .	50.58 (511)	50.33 (89)	+ 0.25
1927 0-Gr. . . .	50.84 (630)	51.07 (160)[1])	÷ 0.21
1930 . . .	50.64 (417)[2])	50.91 (122)[1])[3])	÷ 0.31
1932 0-Gr. . . .	51.05 (1622)	50.58 (52)[1])	+ 0.47
1932 I-Gr. . . .	51.29 (101)	50.68 (81)[1])	+ 0.61

As will appear from these direct comparisons the ray figure of the Belt Sea is at any rate but little above that of the western area of the Western Baltic. The mean number of rays for all plaice (a total of 1 888 ind.) put down for the latter of these waters is 50.53 ± 0.05, and thus it is only slightly lower than the mean figure for all plaice of the year-classes 1927—38 in the Belt Sea (50.72 ± 0.02; 13 113 ind.).

The ray figures found during the Danish investigations in the Western Baltic between Langeland and Als correspond very well with R. Kändler's observations from the Kieler B.:

Langeland—Als . . . . . 50.53 ± 0.05
Kieler B. . . . . 50.78 ± 0.12 } difference 0.25

The mean error of the difference (M. Diff.) between the two analyses is 0.13, and so a real difference between the two results of analysis cannot be established.

A comprehensive comparison between the ray figures of the 0-Gr. fish and the spawning fish cannot be made because corresponding analyses of the two categories are in hand for very few years only:

Spawning fish	0-Gr.
1926/27, 51.14 (83)	1927, 51.07 (160)[1])
1933/34, 50.72 (180)[1])	50.65 (396)

These analyses do not suggest any difference between the ray figures of spawning fish and 0-Gr. individuals, and so they are not indicative of any great influx of larvae from without. The fact, however, that the ray figures are nearly equally high in the Western Baltic and the Belt Sea makes it difficult to judge of an influx of larvae on the basis of ray analyses; but in this connexion it is interesting to notice that the highest (fairly reliable) ray figure observed (51.07, 242 ind.) was found in the year-class that appeared in 1923, that is to say in the very spring in which an extensive influx of haddock larvae from the north was established in the Western Baltic Sea. So it is an obvious conclusion that the high ray figure of this year-class is due to some influx of larval plaice from the north together with the haddock larvae, and at any rate in certain cases such an influx seems to take place. As to the question about an immigration of fish that are a little older R. Kändler (1935) states that no rise of the ray figure is to be found from the 0-Gr. to older age groups, so that an immigration of older individuals (I+-Gr.) cannot be supposed to take place. However, attention was already called to the insignificant difference of ray figures between the Belt Sea and the Western Baltic, and so the lack of such a rise of the ray figure does not justify the conclusion that such an immigration does not occur.

In the eastern area of the Western Baltic (the southern coast of Lolland) the ray figure is somewhat lower than in the western area, as was already stated in the case of the 0-Gr. From the eastern area we have one analysis (from $^{22}/_{4}$ 1922) of older fish, in which the individual year-classes show the following ray figures (for comparison's sake are given the ray figures of the corresponding year-classes in the western area):

Year-class	1919	1918	1917
East. area	49.73 (30)	50.72 (35)	50.22 (32)
West. area	50.24 (33)	49.95 (43)	50.54 (26)

It is seen that the year-classes in most cases show a lower ray figure in the eastern than in the western area of the Western Baltic. The total of individuals examined in the eastern area were found to have the following mean number of rays, which is given together with the corresponding figure for the western area and with the ray figures observed by R. Kändler (No. of ind. in brackets):

Western Baltic, Langeland—Als	S. of Lolland
50.53 ± 0.05 (1888)	50.18 ± 0.15 (237)
50.78 ± 0.12 (695)[4])	50.28 ± 0.11 (511)[4])

[1]) From R. Kändler, 1935.
[2]) II-Gr.
[3]) Older age groups.
[4]) From R. Kändler, 1935.

Thus the water S. of Lolland shows the lowest ray figure observed in analyses including various age groups and year-classes. The only other area in which such a low ray figure was observed is the water Smaalandshavet: here the total of individuals examined from the year-classes 1927—38 were found to have a mean number of 50.19 rays (460 ind.). Thus particularly low ray figures are met with in areas that are either situated far away (S. of Lolland) from the currents of the deep channels through the Belt Sea or in places well delimited from these channels (Smaalandshavet), that is to say in areas where an influx from without cannot well assert itself. In these rather shallow areas we find the lowest ray figure known to occur in a stock of plaice (50.2); evidently this is the purest stock of Belt Sea plaice.

On the Influence of the Transplantations to the Belt Sea on the Racial Character of the Stock of Plaice.

In the years 1928—29 and 1931—36 an annual amount of about $1^1/_4$ million and in 1938 and 39 an annual amount of about 2 million specimens of North Sea plaice were transplanted to the Belt Sea and the adjacent waters (see H. Blegvad, 1935). In view of the fact that the local plaice populations of these waters are not very large one might well suppose that this considerable admixture of North Sea plaice might alter the racial character of the Belt Sea plaice; in this connexion we do not mean the change that follows from the transplanted plaice becoming part of the stock, but the alteration that might be imparted to the racial character of the stock through the spawning of the transplanted plaice in the areas in question. The conditions under which such an alteration of the racial character may take place are 1. that eggs and sperm of the transplanted plaice are able to develop in the Belt Sea, 2. that the racial character—in this case the number of anal fin rays—is established in a hereditary sense, at any rate within comparatively narrow limits, and 3. that the number of spawning transplanted plaice is not too small as compared to the spawning stock of indigenous plaice. As to item 1. we actually know extremely little: W. v. Buddenbrock, 1936, says with a view to the transplantations, "Es ist sehr wohl möglich, dass z. B. die Nordseescholle als solche (as regards faculty of growing) der Ostseescholle überlegen ist, es könnte aber doch sein, dass sie in anderer Hinsicht versagt: Fortpflanzung, Aufsuchen der Laichgründe, etc.". As to the last point we have learnt from the Danish transplantation experiments that the North Sea plaice appear on the local spawning grounds, inasmuch as mature, spawning and spent North Sea plaice are found in rather considerable numbers in the spawning places together with "Baltic" plaice. But of their propagative power we know nothing, and so we have no proof of the prevailing supposition that their eggs and larvae are able to develop in the more brackish water of the Belt Sea and the Western Baltic, but neither have we any proof of the opposite. It is to be hoped that future investigations will solve this problem, which is of great importance not only for the judging of the value of the transplantations but also for the understanding of the racial problem and the recuperation of the stocks of our inner waters. As regards item 2. it may be stated that Johs. Schmidt (1920) during his investigations on the viviparous blenny proved that "the average number of vertebrae ... was altered, if not strongly, at any rate perceptibly, by a transplantation of the population". However, the change in the number of vertebrae found by Johs. Schmidt is but small (about 1.5 vert.) as compared to the difference in number of vertebrae between the various stocks of viviparous blenny (about 5 vert.). As long as we have no similar investigations on the plaice to prove the opposite, there is no reason to believe that this fish will not react in the same way upon the transplantation, and so we may take it for granted that the racial character of the transplanted plaice will be inherited in a form that is but slightly altered at the highest. Concerning item 3., the extent of the spawning of the transplanted plaice in the transplantation areas, much information is gained from the investigations carried out in connexion with the transplantations. H. Blegvad (1935) has examined how large a portion of the plaice transplanted attain maturity in the transplantation areas, basing his investigations partly on the marking experiments carried out, partly on analyses of plaice caught by the commercial fishermen (in these analyses the North Sea plaice were

distinguished by the characteristic look of their otoliths). The investigation shows "that a very large percentage of the males and a considerably smaller percentage of the females transplanted arrive at maturity inside the area of transplantation. Accordingly, we may reckon from 17—32 per cent. of the female and from 74—80 per cent. of the male plaice transplanted to become mature in the transplantation area". Among mature individuals H. Blegvad reckons individuals of the IV—VII stages of maturity. Thus it has been proved that the transplanted plaice are able to produce eggs and sperm in the comparatively brackish water of the Baltic. However, for the purpose of determining the possible influence of the transplanted plaice on the racial characters of the Belt Sea stock it is necessary to know not only how many plaice attain maturity in the Belt Sea, but also the number of plaice that actually spawn here. For it is not at all certain that all the individuals that become mature in the Belt Sea will also remain here until the spawning is finished, and it is a well-known fact that many fish make rather long migrations in the time immediately before the spawning. For the purpose of determining the quantity of transplanted plaice that spawn in the areas of transplantation the following table, which bases partly on H. Blegvad's tables, partly on analyses from the commercial fishery of the years after 1935, gives a survey of the proportion of spawning and spent transplanted plaice (stages of maturity V—VI, VI, and VII). It appears from H. Blegvad's tables that transplanted plaice are found to spawn in the time between December and March, and therefore only plaice caught in these months were included in the table.

Marked transplanted plaice (experiments 1928—33), from H. Blegvad.

	No. of ind.		per cent.		♂+♀	
	♂	♀	♂	♀	No. of ind.	per cent.
not spawning (mat. 0—V)	47	84	65	93	131	81
spawn. (mat. V—VI—VII)	25	6	35	7	31	19

Analyses from the commercial fishery, 1929—34, from H. Blegvad.

	No. of ind.		per cent.		♂+♀	
	♂	♀	♂	♀	No. of ind.	per cent.
not spawning (mat. 0—V)	35	92	51	96	127	77
spawn. (mat. V—VI—VII)	33	4	49	4	37	23

Analyses from the commercial fishery, 1935—39.

	No. of ind.		per cent.		♂+♀	
	♂	♀	♂	♀	No. of ind.	per cent.
not spawning (mat. 0—V)	77	146	66	90	223	80
spawn. (mat. V—VI—VII)	40	17	34	10	57	20

The results of the two series of analysis from the commercial fishery correspond well both *inter se* and with the results of the marking experiments, and so we may consider the found figures rather reliable. In other words: among the transplanted plaice remaining in the transplantation area at the beginning of the spawning season 34—49 per cent. of males and 4—10 per cent. of females are found to spawn here, the number of males thus being high, the number of females rather low.

The number of spawning and spent North Sea fish (mat. V—VI—VII) is somewhat lower than the number of North Sea fish approaching the act of spawning (mat. IV and V). As will be seen from the following figures, however, this difference is found to assert itself with regard to the females only.

	Comm. anal. (1929—34)		Mark. exp. (1929—34)	
	♂	♀	♂	♀
No. of ind. mat. V	31	28	27	9
- - - — V—VI—VII .	33	4	25	6

The fall observed in the number of females from mat. V to V—VI—VII shows that an extensive emigration takes place among the females during the time immediately before the spawning. The disproportion between the numbers of spawning males and females among the transplanted fish is no doubt accounted for by this fact.

When we look at the question of the degree to which the spawning of the transplanted plaice influences the racial character of the Belt Sea plaice and, consequently, the renewal of the stock, the proportion between the numbers of spawning males and females is of less importance. In the three determinations made above of the percentages of males and females collectively the figures were found to be 19, 20 and 23, or roundly speaking 20 per cent. In other words about $^1/_5$ of the transplanted fish found in the Belt Sea during the spawning period breed in this water.

Through the commercial analyses from the areas

of transplantation we may get an impression of what this means in proportion to the local stock of spawning fish. In the commercial analyses from 1930—36 460 spawning Belt Sea fish and 47 spawning fish transplanted were found among a total of 1681 individuals, which means that about $^1/_{10}$ of the fish spawning in the transplantation areas are plaice transplanted from the North Sea. Analyses of fish from the commercial fishery of the last two years (1937 and 1938) show the same proportion between spawning Belt Sea fish and spawning North Sea fish, viz. 383 of the former and 43 of the latter, or a little more than $^1/_{10}$. The fact that the North Sea fish do not make themselves more conspicuous among the spawning fish of the last two years, in which the transplantations were increased by about 70 per cent., is apparently due to the simultaneous rise in the local plaice population of the Belt Sea, the yield of the fishery rising from about 600 000 kg in 1933 to about 1 700 000 kg in 1937. In consequence of the transplantations we might then expect an increase of about 10 per cent. in the amount of fry in the Belt Sea (and adjacent waters). This increase, however, is small in comparison to the natural annual variations in the amount of fry and cannot therefore be established through the annual quantitative investigations of the 0-Gr.; consequently, the unusually rich occurrence of fry in the Belt Sea in certain years (for instance 1934) during the transplantation cannot be put down to the breeding of the transplanted plaice. The breeding of the transplanted plaice cannot cause such sudden rises in the amount of fry, but is of importance because our inner waters by this means benefits from a constant though small admixture of fry.

It remains to be examined whether this increase in the amount of mother fish and consequently—according to our present knowledge—of fry has influenced the ray figure of the plaice fry of the Belt Sea to a perceptible degree. The ray figure of the "Baltic" race is generally put at 50.00, but this figure is too low in the case of the Belt Sea. From the time before the transplantations could influence the racial character of the Belt Sea plaice we have the following analyses of the ray figure of the 0-Gr. in the Belt Sea as a whole:

1924.....50.39 (207 Ind.)
1925.....50.87 (165 -)
1927.....50.85 (681 -)
1928.....50.72 (272 -)

The mean figure of the 4 years is 50.69, and so we may put the mean number of anal fin rays in the Belt Sea plaice at 50.70 in the time before the transplantations. Now the question is how much the ray figure could be raised by a constant annual admixture of mother fish of the North Sea race (with 54.00 rays) amounting to 10 per cent. of the spawning stock already present. In the first spawning season after the commencement of the transplantation there are among 100 spawning fish 10 specimens with 54.00 and 90 with 50.70 rays; this would give a ray figure of 51.03 in the fry provided that the two ray figures are inherited to the same degree and that eggs and sperm of the two races have the same power of development. If the transplantations are continued and due allowance is made for the fact that the hybridous fry by degrees become part of the stock of mother fish, a ray figure of about 51.5 would then be reached in the course of 9 or 10 years, and the 0-Gr. stock of the Belt Sea ought to show a ray figure of 51.50 in 1937 and 1938. In these two years, however, the 0-Gr. of the Belt Sea had a mean of 50.24 (366 ind.) and 50.90 (1 280 ind.) rays, respectively; so the ray figures have not reached the calculated height of 51.5, and their mean does not show any rise as compared to the original figure 50.70. For the different year-classes examined the Belt Sea as a whole shows the following mean numbers of anal fin rays:

Year-class	M. of rays	No. of ind.
1924	50.39	207
1925	50.87	165
1927	50.85	681
1928	50.72	272
1929	50.24	60
1930	50.19	221
1931	49.61	120
1932	50.95	1645
1933	50.74	255
1934	50.71	1655
1935	50.09	1047
1936	49.71	369
1937	50.24	366
1938	50.90	1280
Variation	1.29	..

It appears at once from the figures that no rise of the ray figure is observed in the years during which the transplantations have been taking place (1927—38). It should be remembered, however, that the variation of the ray figure is comparatively high (1.29) and rather higher than the calculated rise

(51.5 minus 50.7 = 0.8). An eventual rise of individual years may thus be covered by the annual variation. A division of the period into two parts does not either show any rise during recent years:

1924—31 (7 years)	50.41
1932—38 (7 years)	50.42

Even if the natural annual variation could easily balance the rise of a single year, we might expect to find a certain rise represented by a higher mean number of rays for the later years of the period, but this is not the case. Although a rise in the ray figure of the fry cannot thus be established, we are not allowed to conclude that the transplantation has been of no importance for the renewal of the stock of fry in the Belt Sea. Firstly, we do not know to what degree the racial characters (in this case the number of anal fin rays) may be influenced by external factors (as for instance salinity and temperature); but several things seem to indicate that the ray figure is indeed influenced by external factors: it may be mentioned that the ray figure of the different year-classes of the eastern North Sea is subject to rather considerable annual fluctuations, the 1933 year-class having a mean of only 53.75 ± 0.04 rays while the 1932 year-class has the high number of 54.82 ± 0.06 rays (cp. Table II). Secondly, we know little or nothing of the laws according to which the number of anal fin rays is inherited by an interbreeding of North Sea plaice and Belt Sea plaice. And thirdly (as mentioned elsewhere on page 35) the possibility exists that a certain selection takes place within the hybridous fry, so that hybrids with a lower ray figure are better fitted to live in more brackish water than those with a high ray figure or in other words that the character "low ray figure" in a hereditary sense is attached to the faculty of living at lower salinities.

In this connexion it is interesting to notice that a fall of the ray figure is observed in the stock of transplanted North Sea plaice during their first year in the Belt Sea, as will appear from the following mean figures of various years in which transplanted plaice were race-analysed partly during the transplantation itself in April, partly later in the year.

This fall of the ray figure may be a consequence either of the highest mortality or the most pronounced tendency to emigrate being found among the individuals that have the highest numbers of rays. In other words some degree of selection seems to be brought about by North Sea plaice with a high ray figure being less fitted to thrive in the Belt Sea than individuals with a low ray figure.

July 1931	53.88	(92	ind.)
Oct. 1931	53.09	(99	—)
Jan. 1932	53.25	(53	—)
July ÷ Jan.	0.53		
July 1932	53.79	(236	—)
Oct. 1932	54.00	(77	—)
Jan. 1932	53.63	(52	—)
July ÷ Jan.	0.16		
April 1937	54.20	(790	—)
Nov.—Dec. 1937	53.25	(20	—)
Jan.—Mar. 1938	53.80	(75	—)
Apr. ÷ Jan.—Mar.	0.40		
April 1938	54.06	(741	—)
Nov.—Dec. 1938	53.91	(77	—)
Jan.—Mar. 1939	53.41	(79	—)
Apr. ÷ Jan.—Mar.	0.65		

These questions, which are so very important for the present investigation and for the racial problem as a whole, can hardly be answered by the ways hitherto followed, viz. countings of rays and vertebrae and a statistical treatment of the material thus obtained. It will be necessary to make direct biological observations (tank experiments or the like) on fairly the same lines as those followed by Johs. Schmidt in his studies on the laws of heredity in fish with non-pelagic fry. With fish with pelagic fry (for instance the plaice) such experiments could not so far be carried out on account of the great difficulties involved in the thriving of the hatched fry. For future investigations into the problem of race it will be a most important task to conquer these difficulties in a way as to establish to what degree the numerical racial characters are influenced by the surroundings or are inheritable; according to what laws such an inheritance takes place; and finally the importance of the selection to the fry that is hatched or grows up under altered conditions.

The Baltic Proper.

Through investigations carried out by R. Kändler (l. c., 1935) we have got an intimate knowledge of the racial character of the plaice population of the Baltic, and the previous results of other investigations are thus supplemented or revised. A. C. Johansen (1929) and Erik M. Poulsen (1932) have shown that the numbers of both rays and vertebrae rises from west to east in the Baltic:

these observations are corroborated by Kändler's comprehensive material. In 1932 the present author attempted to establish the occurrence of a considerable immigration of plaice of the North Sea race (0-, I-, II- and III-Gr.) into the coastal waters off Møen and Falster and into the Arkona Basin from the Kattegat and the Sound. This supposition was based on the observation of 1. a considerably higher number of I-Gr. than of 0-Gr. individuals of the same year-class at the coasts of the Baltic, 2. a rise of the ray figure from younger to older age groups (within the same year-class), and 3. two apices in the graph representing the distribution of anal fin rays. Kändler found no corroboration of this theory of immigration in his material, and he says about this question, "Weder die Betrachtung der Mittelwerte verschiedener Altersgruppen noch die genaue Analyse der Variationskurven der Analflossenstrahlenzahl ergeben Anhaltspunkte dafür, dass Brut and Jungfische aus der Nordsee und dem Kattegat in beträchtlichen Mengen in die Ostsee gelangen". Kändler is possibly right in supposing that the said considerable immigration into the Arkona Basin and the Danish coastal waters does not take place, but it should be noticed that the material on which he bases his proof that no rise of the ray figure takes place from one age group to another within the same year-class, does not originate from the Danish coastal waters with the Arkona Basin but from the Oder Bank Area. To the theory of an immigration into the Arkona Basin from without Kändler further objects that neither in his nor in my analyses nor in both together is the degree of variation (σ) in the ray figure so high, that it corresponds to the one you might expect to find in a mixed stock. It was already pointed out (on page 35) that a mixed stock originating from a natural mixing cannot then and there be supposed to show the same picture of variation as a theoretically mixed material because a certain selection within the immigrated stock must be taken into account. The fact that the coefficient of variation (σ) is low in the separate analyses from the Arkona Basin cannot therefore be looked upon as a proof that the said stocks are not the results of a mixing. However, if a comparison is drawn between all analyses from the Arkona Basin (Kändler, 1935, Erik M. Poulsen, 1932) we get, with a mean number of 51.31 rays, a σ of 2.5, which is considerably higher than the σ of a pure North Sea stock (about 2.0) and of a stock from the Bornholm Deep (barely 2.3). For the rest this σ of 2.50 is rather near to the one stated by Kändler himself for a theoretical mixture with 51.00 rays, viz. 2.63. In investigations like the present no great impertance can be attached to results that are obtained by combining several year-classes, particularly not in a water where the range of variation of the ray figure from one year-class to another is comparatively great. Nevertheless, the facts given above show that the range of variation in the material of plaice from the Arkona Basin with coastal waters is not of a kind as to refute the hypothesis of immigration. In spite of his detailed statistical treatment of the available material of racial analyses from the Baltic Kändler has not been able to solve the problem of a possible influx or immigration into the western area of the Baltic Proper, more particularly on account of the uncertainty involved in the question of a selection in the immigrated stock. Also Kändler leaves open the possibility of an influx of larvae into these areas[1]).

Unfortunately, the Danish material from recent years is so small, that it does not much contribute to the solution of the problems of influx and immigration. In Table VI a are found the ray figures for the 0-Gr. of different year-classes from the Danish coastal areas off the Arkona Basin: $Ø_1$ = Stevns—Møen, $Ø_2$ = Møen—Gedser. The mean figures of the two areas being nearly equally high,

Summary 11.

Year-class	M. of rays	No. of ind.
1902	49.33	15
1906	49.61	254
1925	50.39	59
1927	49.23	73
1928	49.08	36
1929	49.67	3
1930	51.43	7
1931	49.80	5
1932	49.82	11
1933	49.07	14
1934	50.10	64
1935	49.59	43
1936	49.28	7
1937	49.50	2
1938	50.25	16
All year-classes	49.93	609

[1]) R. Kändler uses the term "die westliche Ostsee", but judging from the context he apparently means both the Western Baltic and the Arkona Basin.

in $Ø_1$ 49.88 (84 ind.) and in $Ø_2$ 49.79 (124 ind.), the two sets of analyses are combined in the following survey and given alongside of older analyses from A. C. Johansen, 1928 (see Summary 11).

For all year-classes collectively the mean number of anal fin rays is 49.93 ± 0.09, $\sigma = 2.30$. By way of comparison may be stated that the ray figures of the 0-Gr. in the adjacent waters are:

Southernmost part of the Sound	51.12	(217 ind.)
Smaalandshavet	50.00	(240 —)
Western Baltic, Langeland—Als	50.25	(592 —)
— — S. of Lolland	49.67	(57 —)
— — Mecklenburg Bay	50.21	(475 —) [1]

The plaice population of the southernmost part of the Sound thus shows the same ray figure as that found in the southern regions of the Kattegat, but the 4 other areas have comparatively low figures, and among these again the area S. of Lolland and Smaalandshavet are nearest to the values of the Danish coasts of the Baltic. In these three waters we have the lowest ray figures known in the 0-Gr., the figures that come nearest to the value given for the "Baltic" race (50.00).

Within the 0-Gr. of the different year-classes the ray figure varies by 1.25—if analyses including more than 50 individuals only are considered. Low ray figures are found in the 1906 and 1927 year-classes, which have 49.61 and 49.23 rays, respectively; high ray figures are observed in the 1925 and 1934 year-classes with 50.39 and 50.10 rays, respectively. On account of the rather small numbers of 0-Gr. individuals examined a comparison with the ray figures of the spawning fish is of less importance; but still it is worth noticing that the ray figures of the 0-Gr. in all years considered are considerably lower than those of the spawning fish (from the Hjelms B., see Table I), the 0-Gr. showing the low figure of 49.93 (609 ind.), the spawning fish the high figure of 51.16 (366 ind.). An even poorer correspondence is found between the ray figures of 0-Gr. and spawning fish in the proper Arkona Basin, in which the latter category, according to R. Kändler (1935), has a mean of about 51.9 rays. Of direct observations of the spawning stock and the subsequent 0-Gr. we only have the following (the spawning fish of the analyses in 1928 and 1931 were taken from the Hjelms B. and the western edge of the Arkona Basin, in 1933 from remoter parts of the Arkona Basin):

Spawning fish, spring of 1928	51.39	(158 ind.)
— — 1931[1]	51.27	(33 —)
— — — 1933[1]	51.95	(161 —)
0-Gr., summer of 1928	49.08	(36 ind.)
— — 1931	49.80	(5 —)
— — 1933	49.07	(14 —)

Although the numbers of 0-Gr. fish examined are very small, the comparison indicates a much lower ray figure for the 0-Gr. than for the spawning fish.

Of various year-classes of I-Gr. fish we have the following material of countings of anal fin rays, originating partly from the coastal investigations between Stevns and Gedser, partly from experimental fishings in the Hjelms Bay.

Year-class	M. of rays	No. of ind.
1901	49.10	101
1905	49.90	71
1906	50.07	41
1927	49.59	58
1928	50.41	32
1929	49.62	8
1930	50.38	13
1932	52.00	1
1934	50.52	33
1935	51.41	17
1936	50.00	1
1937	50.00	1
All year-classes	49.84	376

Thus the ray figures of the 0-Gr. and I-Gr. are of nearly the same height. If the year-classes are reviewed separately, there seems to be a slight difference, the ray figures of the I-Gr. being a little higher:

Year-class	0-Gr.	I-Gr.
1906	49.61 (254)	50.07 (41)
1927	49.23 (73)	49.59 (58)
1928	49.08 (36)	50.41 (32)
1934	50.10 (64)	50.52 (33)
1935	49.59 (43)	51.41 (17)

From this rise of the ray figure and from the fact that the stocks of plaice occurring near the coasts (at depths of 1—3 m.) contain much more I-Gr. than 0-Gr. individuals, I have formerly drawn the conclusion that a certain immigration of plaice of $^1/_2$—$1^1/_2$ years of age into this area is going on from without (from the Sound). But there is another possibility, viz. that these immigrating fish come

[1] From R. Kändler, 1935.

from the Arkona Basin where there is a stock of spawning plaice with 51—52 rays, and that they principally consist of such individuals of the 0-Gr. that do not make for the coasts until at a comparatively advanced age (about $^3/_4$ year old).

Investigations from the Hjelms B. of individuals older than the I-Gr. are not very extensive. The Summary 12 gives the numbers of anal fin rays in II-Gr. and older individuals of the different year-classes:

Summary 12.

Year-class	M. of rays	No. of ind.
1922	51.00	23
1923	51.76	63
1924	51.72	51
1925	51.12	68
1926	49.25	4
1927	51.33	3
1928	51.80	5
1929	51.13	16
1930	50.65	31
1933	50.33	3
1934	51.41	22
1935	52.00	9
1936	51.50	2
All year-classes	51.29	300

In other words the mean figure (51.29 ± 0.13, $\sigma = 2.30$) of these older individuals, a large amount of which belong to the spawning stock, is considerably higher than the means of the 0- and I-Gr., the difference being about 1.4. If this material is divided into two age-classes, we get the following result: II- and III-Gr. 51.10 ± 0.19, $\sigma = 2.12$ (135 ind.); IV+-Gr. 51.45 ± 0.19, $\sigma = 2.37$ (165 ind.). These ray figures coincide with the figures of the spawning fish, which in the Hjelms B. are 51.16 (366 ind.) according to the Danish investigations and 51.27 (33) according to the German. That this considerable difference between the ray figures of 0- and I-Gr. on one side and of older individuals on the other is not due to accidental circumstances caused by changing amounts of individuals of the separate year-classes, appears from the following comparison of year-classes:

Year-class	0-Gr.	I-Gr.	older (II+-Gr.)
1906	49.61 (254)	50.07 (41)	..
1925	50.39 (59)	..	51.12 (68)
1927	49.23 (73)	49.59 (58)	51.33 (3)
1928	49.08 (36)	50.41 (32)	51.80 (5)
1929	49.67 (3)	49.62 (8)	51.13 (16)
1930	51.43 (7)	50.38 (13)	50.65 (31)
1934	50.10 (64)	50.52 (33)	51.41 (22)
1935	49.59 (43)	51.41 (17)	52.00 (9)

So there is a conspicuous difference of ray figures between the young fish of the 0- and I-Gr. that stand along the eastern and southern coasts of Møen and Falster and to some degree in deeper water in the Hjelms B. and the stock of slightly older fish and spawning fish that occur at depths of 15—30 m. in the Hjelms B. only a few nautical miles away from the coast. This means that a considerable part of the stock of older fish found in the Hjelms B. must have immigrated from elsewhere; however, it is equally possible that 1. part of the 0- and I-Gr. fry that grow up along these coasts or in the very Hjelms B. must originate from elsewhere (Smaalandshavet or the Western Baltic); or 2. that it represents only part of the fry hatched in the Hjelms B. while the rest is supposed to grow up in deeper water. The heterogeneity of the stocks of fry and spawning fish also appears from the fact that a joint review of the spawning stock (in the spring of 1928) and the corresponding fry (0-Gr. in 1928, I-Gr. in 1929) gives a comparatively wide range of the ray figures, σ being as high as 2.50. The most obvious explanation seems to be that the fry going to the coast from the spawning places is composed principally of individuals with low ray figures while the 0-Gr. individuals with high ray figures remain in much deeper water, as seems to be the case at the coast of Bornholm (see page 52).

From the proper Arkona Basin we have no Danish investigations, but we know from R. Kändler's investigations (l. c., 1935) that a stock of spawning plaice with a ray figure of nearly 52.0 is found along the southern edge of the Arkona Basin and that stocks of young fish with between 51.5 and 52.4 rays occur at the German coasts of the Arkona Basin (the northern and western coasts of Rügen). In the coastal waters E. of Rügen and in the Oder Bank Area, however, some Danish investigations have been carried out; part of these, from the years 1928—31, were previously dealt with by the present author (1932); furthermore, R. Kändler (1935) has made a close study of the plaice population of this area.

The following analyses of 0-Gr. fish are in hand from the Oder Bank Area:

Year-class	1928	1930	1934	1938	All year-classes
M. of rays	51.85	51.90[1])	51.39[2])	48.37	51.45 ± 0.16 (σ 2.55)
No. of ind.	13	113	122	16	264

[1]) According to R. Kändler 51.73 (242).

[2]) According to R. Kändler 52.02 (540).

The low ray figure of the few individuals from 1938 is possibly due to a certain admixture of "Leps" because comparatively many specimens were found to have 47 rays, as will appear from the following tabular survey of the variation of rays in the 0-Gr. analyses mentioned above.

No. of rays	1928	1930	1934	1938
44	1	..	..	..
45	..	..	1	2
46	..	1	2	2
47	..	2	5	4
48	..	7	7	1
49	1	8	11	2
50	1	9	20	2
51	2	19	18	1
52	2	17	19	1
53	2	23	10	..
54	1	15	17	..
55	3	8	6	1
56	..	3	4	..
57	..	1	2	..
No. of ind.	13	113	122	16

In the rest of the year-classes the admixture of "Leps" at any rate seems to be quite insignificant. The total number of rays, 51.45, is high, about $1^1/_2$ ray higher than at the Danish coasts of the Baltic off the Arkona Basin.

Of I-Gr. analyses of the number of anal fin rays we have the following series:

Year-class	M. of rays	No. of ind.
1929	51.22	81
1930	51.47[1])	47
1932	52.00[2])	1
1934	51.47	34
1935	51.58	31
1936	51.00	2
1937	50.33	3
All year-classes	51.39 ± 0.15 (σ 2.17)	199

Thus the ray figure is nearly the same in the 0-Gr. and the I-Gr.: also the I-Gr. has a much higher ray figure in the Oder Bank Area than at the eastern coasts of Møen and Falster. The distribution of the number of anal fin rays within the different year-classes of the I-Gr. appears from the following (the 1932, 1936 and 1937 year-classes not included):

No. of rays	1929	1930	1934	1935
46	1	..	1	1
47	3	1	1	1
48	9	1	4	3
49	7	5	3	4
50	7	7	4	1
51	12	8	4	3
52	20	12	3	8
53	11	7	4	1
54	6	4	5	4
55	3	2	4	3
56	1	..	1	1
57	1	..	..	1
No. of ind.	81	47	34	31

Of the older age groups we have the following analyses from this area (No. of ind. in brackets):

Year-class	II-Gr.	III-Gr.	IV+-Gr.
1928	52.24 (263)	..	..
1930	..	51.26 (39)	..
1934	51.81 (198)	52.01 (197)	..
1935	51.50 (60)	..	..
Total	52.01 (530)[3]) σ 2.28	51.85 (246)[4]) σ 2.22	51.95 (19)

For the different age groups we then have the following numbers of anal fin rays, the corresponding figures for the Hjelms B. Area being given for the sake of comparison.

Gr.	The Oder Bank	The Hjelms B.
0	51.45 ± 0.16	49.93 ± 0.09
I	51.39 ± 0.15	49.84 ± 0.11
II	52.01 ± 0.10	51.10 ± 0.19
III	51.85 ± 0.14	
IV+	51.95 ± 0.51	51.45 ± 0.19

We see that the various age groups of the Oder Bank Area differ slightly as regards the number of anal fin rays; the greatest difference is found between the I- and II-Gr. where it is 0.62 ± 0.18 or a little more than thrice its mean error, but no great weight can be attached to this difference because the year-classes examined were different ones. In the Hjelms B. Area we find quite another state of things: here the difference between the I-Gr. on one hand and the IV+-Gr. on the other is 1.61 ± 0.22 or more than 7 times its mean error. Quite obviously, the two youngest age groups of the Oder Bank Area belong to the same stock as the older age groups while in the Hjelms B. the former diverge greatly from the latter. Through his racial analyses R. Kändler

[1]) According to R. Kändler 52.01 (164).
[2]) According to R. Kändler 51.29 (35).
[3]) Including 9 ind. of the year-classes 1929 and 31.
[4]) Including 10 ind. of the year-classes 1928, 32 and 33.

Ta

Area	Bo. 1								
Year-class	1925	1926	1928	1931	1932	1934	1936	1937	1938
43	..	..	..	..	..	..	..	..	..
44	..	..	..	..	..	1	..	..	2
45	1	..	..	..	..	4	1	..	..
46	..	1	..	..	1	4	1	3	3
47	..	..	..	..	..	12	..	1	5
48	..	..	..	..	2	20	2	1	14
49	..	..	..	..	..	13	4	4	8
50	..	..	1	..	2	29	1	3	11
51	..	..	..	1	1	30	2	..	19
52	..	..	..	..	1	34	1	2	11
53	..	..	..	..	1	24	..	..	8
54	..	..	1	..	..	23	..	1	7
55	..	..	..	..	..	12	..	1	4
56	..	..	..	..	..	8	..	..	1
57	..	..	..	..	..	..	..	..	..
58	..	..	..	..	..	1	..	..	1
59	..	..	..	..	..	1	..	..	..
Total	1	1	2	1	8	216	12	16	94
Mean	45.0	46.0	52.0	51.0	49.75	51.19	48.92	49.50	50.55
$m \pm$	..	..	..	..	..	0.18	..	..	..
σ	..	..	..	..	..	2.70	..	..	..

ler (1935) found that the young fish of the Oder Bank possess nearly the same racial character as the spawning fish of the Arkona Basin and the Bornholm Deep; most of the year-classes correspond to the spawning stock of the Bornholm Deep, and only one year-class (1929) is more closely connected with the Arkona Basin.

In the Oder Bank Area different year-classes were found to have the following mean numbers of anal fin rays (year-classes of which less than 25 individuals were examined are not included):

Year-class	M. of rays	No. of ind.	σ	M. of rays according to Kändler 1935	
1928	52.16 ± 0.14	286	2.35	52.22 ± 0.18	$\sigma = 2.15$
1929	51.24 ± 0.23	97	2.26	51.78 ± 0.23	$\sigma = 2.23$
1930	51.67 ± 0.15	199	2.16	51.76 ± 0.09	$\sigma = 2.33$
1934	51.77 ± 0.10	551	2.27	52.02 ± 0.10	$\sigma = 2.26$
1935	51.53 ± 0.21	117	2.23	..	..

The difference between the ray figures of the individual year-classes is not very great, amounting to 0.92 ± 0.26 at the highest (between the 1929 and 1928 year-classes). This difference, which is between 3 and 4 times its mean error seems to indicate that the population of young fish in the Oder Bank Area does not originate from quite the same stock of fry in all years. As the spawning stock of the Arkona Basin (see page 10) has a little lower ray figure than that of the Bornholm Deep, there is reason to suppose that low ray figures in the fry of the Oder Bank Area are caused by an intense admixture from the Arkona Basin and high ray figures by an intense admixture from the Bornholm Deep. Basing principally on countings of vertebrae and on investigations on the number of complex formations in the vertebral column R. Kändler (1935) admits the possibility that the fry population of the Oder Bank Area is the result of a mixing of fry from the Arkona Basin and the Bornholm Deep. The present material of countings of anal fin rays seems to corroborate this supposition, which was not borne out by Kändler's countings from the Oder Bank: he arrives at the result that "Die Schwankungen der Jahrgangmittel scheinen — wenigstens soweit wir gegenwärtig Einblick haben — nicht hervorgerufen zu werden durch Mischung zwei unterschiedlicher Formen verschiedener Herkunft; dafür fehlen alle Parallelen in der Gestaltung der einzelnen Merkmale". Such a parallelism of the variation of the individual characters was established at any rate in the case of one year-class: in the Danish investigations the 1929 year-class decidedly showed a low ray figure (a higher one, however, in the German investigations), and Kändler found that this year-

	Bo. 2									Bo. 1+2
1907	1925	1928	1932	1933	1934	1936	1937	1938	Total	Total
..	..	2	..	..	..	..	..	..	2	2
..	..	1	..	..	1	..	..	1	3	6
..	1	4	..	..	6	..	..	2	13	19
..	..	6	..	..	7	2	..	1	17	30
..	2	5	..	..	11	1	..	1	23	41
1	3	10	1	..	21	..	..	9	46	85
..	9	13	..	1	27	..	..	8	61	90
..	5	11	3	1	27	1	..	6	56	103
..	3	8	2	..	40	..	..	12	71	124
..	3	12	..	1	29	1	..	5	55	104
..	..	9	..	..	28	..	2	6	46	79
..	2	6	..	..	20	..	..	1	34	66
..	1	4	..	..	17	..	..	2	24	41
..	..	..	..	..	2	..	..	1	3	12
..	..	3	..	..	1	..	..	..	4	4
..	..	1	..	..	2	..	..	..	3	5
..	..	..	..	..	..	..	..	..	..	1
1	29	95	6	3	239	5	2	55	461	812
48.0	49.86	50.21	50.0	50.33	50.90	48.2	53.0	50.20	50.56	50.66
..	..	0.33	..	..	0.17	..	..	..	0.13	0.10
..	..	3.19	..	..	2.68	..	..	..	2.73	2.73

class, as far as numbers of vertebrae and complex formations are concerned, is more closely connected with the stock of the Arkona Basin than with that of the Bornholm Deep. However, the establishment of a mixed character in the fry of the Oder Bank Area is rendered difficult by the fact that there is so small difference of racial character between the plaice populations of the Arkona Basin and the Bornholm Deep. However, the mere regional conditions are greatly in favour of an immigration of fry into the Oder Bank Area from both of these spawning areas.

When the 1929 year-class is left out of consideration, the Danish and German investigations show a close correspondence between the mean numbers of anal fin rays; between the mean figures of the year-classes considered in the two series of investigation there is the following mean difference:

Year-class	Difference
1928	0.06 ± 0.23
1929	0.54 ± 0.32
1930	0.09 ± 0.17
1934	0.25 ± 0.15

Thus the difference is in no case twice the mean error. This close correspondence between analyses of the same stock carried out by two different persons shows that the personal error in countings like these is extremely small. Only the 0-Gr. of the 1934 year-class shows a rather considerable difference between the results of the Danish and German investigations: German 52.02 ± 0.10, Danish 51.39 ± 0.23, the difference between the two figures thus being 0.63 ± 0.25 or between 2 and 3 times its mean error. The difference is possibly due to the fact that the Danish material principally originates from the "Sassnitzer Graben" (depth: 17—23 m.) in the immediate vicinity of the coast while the greater part of the German material was caught in somewhat deeper water between the Oder Bank and the Arkona Basin.

A comparison of the young fish populations in the Oder Bank Area and at the eastern coasts of Falster and Møen with the stock of older fish in respectively the western and southeastern part of the Arkona Basin thus reveals the conspicuous fact that a close correspondence of ray figures exists between young and older fish in the Oder Bank Area on one side and the stock of the southeastern Arkona Basin on the other, whereas the stock of young fish in the Møen—Falster Area has a much lower ray figure than the older plaice of the western Arkona Basin.

In the water round Bornholm analyses of

0-Gr. fish were carried out during recent years (see Table 6). For the working of the material the coast of Bornholm was divided into two areas: Bo_1 from Hammeren along the western and southern coast to E. of Arnager and Bo_2 from W. of Dueodde along the eastern and northern coast to Hammeren, Bo_1 thus being the coastal area that faces the Arkona Basin, Bo_2 fronting the Bornholm Deep. The subjoined survey contains the numbers of anal fin rays in 0-Gr. fish from different years (No. of ind. in brackets):

Year-class	Bo. 1	Bo. 2
1894	..	50.73 (26)
1907	..	48.00 (1)
1925	45.00 (1)	49.86 (29)
1926	46.00 (1)	..
1928	52.00 (2)	50.21 (95)
1931	51.00 (1)	..
1932	49.75 (8)	50.00 (6)
1933	..	50.33 (3)
1934	51.19 (216)	50.90 (239)
1936	48.92 (12)	48.20 (5)
1937	49.50 (16)	53.00 (2)
1938	50.55 (94)	50.20 (55)
All year-classes	50.80 (351)	50.56 (461)

The mean figure is nearly equally high in both areas, being 50.80 ± 0.15 at the coasts off the Arkona Basin and 50.56 ± 0.13 at the coasts off the Bornholm Deep; for both coastal areas collectively the ray figure (812 ind.) is 50.66 ± 0.10. When analyses of less than 50 ind. are rejected, the variation of the year-classes is for Bo_1 0.64 and for Bo_2 0.70. For the rest it seems to be the rule for both areas that abundant year-classes have high ray figures and poor year-classes low ray figures.

In the different coastal areas of the Baltic Proper the 0-Gr. (all examined year-classes collectively) possesses the following numbers of anal fin rays:

$Ø_{1+2}$ (Seeland, Møen and Falster)	49.93 ± 0.09
The Oder Bank Area	51.45 ± 0.16
Bo_1 (W. of Bornholm)	50.80 ± 0.15
Bo_2 (E. of Bornholm)	50.56 ± 0.13

In other words there is a distinct rise of the ray figure from $Ø_{1+2}$ to the Oder Bank Area; but a fall is observed from the Oder Bank Area towards the north and northeast to the Bornholm Deep. Between the Oder Bank and Bo_1 the difference is 0.65 ± 0.21 and between the Oder Bank and Bo_2 it is 0.85 ± 0.20, in both cases more than thrice its mean error. This distinct difference between these three rather closely situated areas is the more surprising as the number of anal fin rays is nearly the same in the spawning stocks from which the said stocks of 0-Gr. individuals are derived. The 0-Gr. of the Oder Bank Area and the coasts of Seeland, Møen and Falster is recruited from the spawning stocks of the Bornholm Deep and the Arkona Basin (R. Kändler, 1935), and there can hardly be any doubt that the 0-Gr. at the western coast of Bornholm is recruited principally from the Arkona Basin and the 0-Gr. at the eastern coast mainly from the Bornholm Deep. In the latter area the mean figure of the spawning stock is 52.00, and in the Arkona Basin it is 51.95 (R. Kändler, 1935).

The observed difference of ray figure between the 0-Gr. of various parts of the Baltic might be supposed to be due to an unequal representation of the different year-classes in the different areas; but if the year-classes are examined separately, we find a similar difference between the ray figures of the 0-Gr.

	1928 year-class	1934 year-class
$Ø_{1+2}$	49.08 (36)	50.10 (64)
Oder Banke	51.85 (13)	51.39 (122)[1]
Bo_1	52.00 (2)	51.19 (216)
Bo_2	50.21 (95)	50.90 (239)

On account of the paucity of the material only the rich year-classes can be compared, and these year-classes of all others possess high ray figures at the coast of Bornholm. So the difference between the various year-classes is less conspicuous here, but still it is great enough to show that the 0-Gr. has a lower number of anal fin rays at the coasts of Bornholm than in the Oder Bank Area. In the latter area the 0-Gr. has the same ray figure as the older age groups including the spawning fish of the adjacent areas. At the coasts of Bornholm, however, the ray figure of the 0-Gr. is considerably below that of the spawning fish (in the Arkona Basin and the Bornholm Deep). Already in 1932 (Erik M. Poulsen, l. c.) attention was called to this difference between the ray figures of the 0-Gr. and the older age groups, the following figures of the different age groups (investigations from the years between 1896 and 1931) being given for the Bornholm Deep with the adjacent coastal waters of Bornholm:

0-Gr.	II-Gr.	III-Gr.	IV+-Gr.
50.76 (321)	51.71 (55)	51.19 (158)	51.31 (72)

[1]) According to Kändler 52.02 (544 ind.).

Thus the difference between 0-Gr. and II+-Gr. is 0.64, the mean figure of the II-, III- and IV+-Gr. being 51.40.

Together with the Danish material published in 1932 the additional material of recent years yields the following ray figures for the different age groups in the areas round Bornholm (No. of ind. in brackets):

Gr.	Bo_1 = The Arkona Basin	Bo_2 = The Bornholm Deep
0	50.80 (351)	50.56 (461)
I	50.80 (35)	49.85 (46)
II	49.25 (4)	51.76 (62)
III	51.61 (51)	51.19 (199)
IV+.....	51.45 (47)	51.32 (156)
II +.....	51.44 (102)	51.31 (417)

From the 0-Gr. to the I-Gr. no rise is observed, but at any rate in the Bornholm Deep the ray figure of the II-Gr. is already much higher than that of the 0-Gr. (and the I-Gr.); the figures of the older age groups are comparatively uniform and no higher than those of the II-Gr. In the Areas Bo_1 and Bo_2 the difference between the ray figures of the 0-Gr. and the II+-Gr. is 0.64 ± 0.27 and 0.75 ± 0.17, respectively. In other words: for Bo_1 the difference is rather more than twice, for Bo_2 a little more than 4 times its mean error. So it is obvious that all year-classes collectively in these areas show a rise of the ray figure from the 0-Gr. (and the I-Gr.) to the II+-Gr. If the year-classes are looked at separately, we get the following picture of the variation of the ray figure from the youngest to the older age groups (No. of ind. in brackets):

W. of Bornholm—the Arkona Basin:

Year-cl.	I-Gr.	IV+-Gr.	Difference (IV+-Gr. ÷ I-Gr.
1927	50.80 (35)	51.65 (51)	$+ 0.85 \pm 0.46$

E. of Bornholm—the Bornholm Deep:

Year-cl.	0-Gr.	I-Gr.	II-Gr.	III-Gr.	IV-Gr.	V-Gr.	VI+-Gr.	II+-Gr.	II+-Gr. ÷ 0-(I-)Gr.
1925 ...	49.86 (29)	..	..	51.36 (47)	..	..	52.50 (2)	51.41 (49)	$+ 1.55 \pm 0.52$
1927 ...	..	49.75 (12)	..	50.99 (126)	51.53 (225)[1]	..	51.82 (91)[1]	51.54 (442)	$+ 1.79 \pm 0.55$
1928 ...	50.21 (95)	..	51.71 (55)	52.19 (48)[1]	..	52.34 (513)[1]	51.60 (14)	52.27 (216)	$+ 2.06 \pm 0.33$

Thus it appears from the figures in hand that—at any rate in the waters E. of Bornholm—a distinct difference exists between the ray figures of the 0- and I-Gr. on one side and of the older fish on the other, the latter being $1^1/_2$—2 higher than the former. But in this very area the III-Gr. and older fish represent the spawning stock, and so there is here—as in the northwestern part of the Arkona Basin—a conspicuous disproportion between the ray figures of fry and spawning fish. This fact also appears from a direct comparison between the ray figures of the fry and the mother fish E. of Bornholm (in the water W. of Bornholm no such comparison can be made on account of the paucity of the material).

Spawn. fish E. of Nexø $^{25}/_{8}$ 1928 (Table I)	51.36 ± 0.24	Difference 1.15 ± 0.40
0-Gr., summer of 1928	50.21 ± 0.32	
Central Bornholm Deep, April 1933 (from Kändler)..	52.10 ± 0.16	Difference 1.20 ± 0.23[2]
0-Gr. Bo_2, summer of 1934	50.90 ± 0.17	

As mentioned above this direct comparison also reveals a distinct difference of ray figures between the spawning fish and the fry that descend from them. This state of things is the more remarkable as a corresponding difference does not exist between the 0-Gr. stock of the Oder Bank Area and the spawning fish of the Bornholm Deep or the Arkona Basin. In the coastal regions round the Oder Bank and off Stolpemünde and Kolberg Kändler in 1934 found the 0-Gr. to have a ray figure of 52.22 ± 0.06, that is to say of the same height as that observed in the mother fish of the Bornholm Deep in April, 1933, and considerably higher than the ray figure of the 0-Gr. at the eastern coast of Bornholm in 1934.

The difference of ray figures at Bornholm can hardly be put down to an influx of larvae with low ray

[1]) From R. Kändler, 1935.

[2]) As the mother fish date from April, 1933 and the fry from the summer of 1934, the stocks of mother fish and fry examined are not absolutely interdependent; but there is no reason to believe that the stock of mother fish have been subject to any great changes from April, 1933 to the spring of 1934 (it may be mentioned here that an analysis of 44

figures from elsewhere or to an immigration of older fish with comparatively high ray figures because the areas (the Western Baltic and the Kattegat) from which such an influx or immigration might take place are so very remote. However, we get a possible explanation if we suppose 1. that the 0-Gr. stock growing up at the coast of Bornholm constitutes but part of the fry that originates from the spawning in the Bornholm Deep, and 2. that a certain selection takes place among the bottom stages of the 0-Gr. when the migration to the coast begins, so that the immigrating fry is principally composed of individuals with a low number of anal fin rays. Indeed, certain facts in our material are in favour of such a hypothesis: of the 239 0-Gr. individuals caught in Area Bo_2 in 1934 by far the greater part (210) originate from the inshore waters and were caught in shrimp net or in Johansen's Young Fish Trawl at depths between $^1/_4$ and 2 m., while the remaining 29 individuals were taken in eel-seine S. of Dueodde at depths of 32—35 m. Between these two stocks the following difference of ray figure was observed:

$^1/_4$—2 m's depth	50.77 ± 0.19 (210 ind.)
32—35 - —	51.93 ± 0.41 (29 ind.)
Difference	1.16 ± 0.45

Of course the mean error is rather great on account of the paucity of the material, but still the difference is about $2^1/_2$ times its mean error, and thus the comparison seems to indicate a certain difference of ray figure between the two stocks of 0-Gr. fish, the lower ray figure being found in shallow water. This point of view also helps us to understand the apparently inexplicable difference between the ray figures of the 0-Gr. at Bornholm and in the Oder Bank Area. Kändler's 0-Gr. individuals of the 1934 year-class have a ray figure of 52.2, which is a high one, but then all of them were taken at some distance from the coast at depths of more than 7 m., the majority even at depths between 20 and 30 m.[1]):

The Oder Bank Area	52.02	— abt. 90 per cent. of them betw. 18 and 30 m., 10 per cent. betw. 7 and 13 m.
Kolberg	52.37	— more than 99 per cent. betw. 19 and 45 m.
Stolpemünde	52.38	— abt. 63 per cent. betw. 24 and 33 m., 37 per cent. betw. 11 and 17 m.

spawning plaice from Christiansø in June, 1935 showed a ray figure of 52.12 or the same as in April, 1933).

[1]) R. Kändler, 1935, 1 and 2.

Kändler does not state the ray figure for the various depths, but a comparison between the Oder Bank Area and the Kolberg Area seems to show that the lowest ray figure of the 0-Gr. is found in the shallower water—a recurrence of the state of things at Bornholm. As mentioned on page 49 the Danish 0-Gr. material from the Oder Bank Area in 1934 had a somewhat lower ray figure than the German: 51.39 against 52.02; this difference is possibly due to the fact that most of the Danish material originates from somewhat shallower water than the German: 19 individuals with a ray figure of 52.00 were taken at depths between 15 and 17 m. and 103 individuals with 51.28 rays between 22 and 23 m. The fact that the ray figure is lower in deep than in shallow water may be due to the small number of individuals examined. In the autumn of 1930 a slight difference of ray figures was observed between the 0-Gr. fish from shallower and from deeper water:

6—13 m	51.83 (86 ind.)
20—21 m	51.73 (242 ind.)[2])
16—40 m	52.11 (27 ind.)

On the whole the present analyses thus seem to indicate that the 0-Gr. stock found in summer at the coasts of the Baltic in quite shallow water has a lower ray figure than the stock found in somewhat deeper water. For an absolutely safe establishment of these circumstances the material is still insufficient; for this purpose it will be necessary to procure a comprehensive material from the same year of 0-Gr. individuals both from the littoral zone and from somewhat deeper water off the coast. If future investigations corroborate the results achieved by an examination of the present material, it means that a certain selection takes place when the 0-Gr. individuals reach the bottom stage, so that individuals with a comparatively low ray figure principally go coastwards while individuals with higher ray figures remain in deeper and, consequently, somewhat salter water. But this again means that —within the same stock—plaice with a low number of anal fin rays are more tolerant of low salinities than plaice with a high number. In this connexion it should be remembered that—as mentioned on page 43—among the North Sea plaice transplanted to the Belt Sea individuals with a high number of rays show a more pronounced tendency to emigrate (to salter water) than individuals with low ray

[2]) R. Kändler, 1935, 1 and 2.

figures. Furthermore, the present statements are in favour of the hypothesis advanced on page 35 to the effect that among the larvae of the North Sea race that are carried into the Belt Sea a higher mortality is found in individuals with a high than in individuals with a low number of anal fin rays.

Conclusion.

On the previous pages we have followed the changes in the number of anal fin rays of the plaice, partly regionally—from one water to another, partly chronologically—from year to year or rather from one year-class to another, through an area reaching from the eastern part of the North Sea to the central part of the Baltic.

In the North Sea with the Skagerak the regional changes are but small, at the highest 0.5 ray within the same year-class even when the northwesternmost (Scotland) and the southwesternmost areas (the Channel) are included (see page 5). But even within still wider areas the ray figure is of the same size order as in the North Sea. At Iceland the following numbers of anal fin rays were observed:

Year-class ..	1901	1909	1924	?	?
M. of anal fin rays..	54.12	55.51	53.73	54.36	54.37
No. of ind..	100	63	229	50	16
Investigator	A. C. Johansen	A. Strubberg[1])	Å. V. Tåning	C. V. Otterstrøm	A. C. Johansen

and from the Barent Sea Awerinzew (1929) gives the figure 54.69 ± 0.13. Although these ray figures as a whole are a little higher than those known from the North Sea, they are still within the range of the North Sea plaice when the mean error is taken into consideration. Thus we see that within the large marine area from the Channel to the Barent Sea and from the western coast of Jutland to Iceland the regional variations are but small, a fact that also appears from the following mean figures from the Horns Reef (1928—36), Iceland and the Barent Sea (different year-classes):

The Horns Reef	54.03	4504	ind.
Iceland	54.15	458	—
The Barent Sea	54.69	308	—

the difference between the highest and the lowest figure thus being only 0.66 ray. The chronological changes, however, are comparatively great and greater than the regional ones:

The Horns Reef
lowest ray figure, 1931 year-cl. 53.67 (258 ind.)
highest - - 1932 — 54.82 (576 —) Diff. 1.15

Iceland
lowest ray figure, 1924 year-cl. 53.73 (229 ind.)
highest - - 1909 — 55.51 (63 —) Diff. 1.78

Thus the chronological variation is much greater than the regional variation in both areas.

However, if we go in an eastward direction from the North Sea into the inner Danish waters and further into the southern Baltic, we find a very distinct variation both in a regional and a chronological point of view, but here the former variation is much more pronounced than the latter. In the comparatively small area from the Skaw to Bornholm the mean number of anal fin rays ranges between 49.5 and 54.0: through the Kattegat the ray figure falls from about 54.0 to about 51.0; a further fall to about 50.5 is observed in the Belt Sea, and to about 50.0 in the waters S. of Falster and Lolland; in the eastern Baltic it rises again to about 51 or 52 in the water round Bornholm. The variation in the number of rays (and vertebrae) is considered expressive of the presence of 2 races of plaice: the North Sea race and the Baltic race. Kändler (1935) distinguishes between an Atlantic form, the habitat of which is the Channel, the North Sea, the waters at Iceland and the Barent Sea, and a Baltic form, which occurs in the Belt Sea and the Baltic. This interpretation is nearly the same as the older conception: only "North Sea" has been modified into "Atlantic", and the preciser expression "race" has been replaced by the more neutral word "form".

A look at the map (Figure 1), on which the mean numbers of rays and the standard deviation for stocks of spawning plaice are marked off (cp. Table I), will show that the area of investigation may be subdivided into 3 areas: one showing a high ray figure (the North Sea, the Skagerak and the north-

[1]) From Å. Vedel Täning, 1929.

eastern Kattegat), another with a low ray figure (the southwestern Kattegat, the Sound, the Belt Sea and the Western Baltic), and a third area with a comparatively high number of rays (the Baltic Proper). Such a regional variation can hardly be explained from the presence of two forms of plaice (Atlantic and Baltic), but is more easily accounted for if we assume the existence of 3 forms: an Atlantic (or North Sea) form, a Belt Sea form and a Baltic form. The numbers of anal fin rays in these 3 forms (or races) are then:

North Sea form	about 54.0
Belt Sea form	- 50.5
Baltic form	- 52.0

In the border areas between the habitats of these 3 forms mixed stocks are found. Between the North Sea and the Belt Sea form we thus find mixed stocks in the eastern Skagerak and in the northern and northeastern Kattegat where the following ray figures and standard deviations are observed:

N. of the Skaw.....	53.17	2.63	196 ind.
Vinga—Læsø.....	52.53	2.94	66 —
The Skaw—Læsø.....	51.38	2.66	85 —
At Anholt.....	51.06	2.65	134 —

The high standard deviation (2.6—2.9) shows distinctly enough that the said spawning stock does not make up an independent race with an intermediary ray figure; in other words plaice of the North Sea form and the Belt Sea form spawn within this area at the same time and in the same locality, that is to say side by side. So the generally accepted conditions of the presence of these two forms as races—the separation of the spawning stocks—are not verified. From this area in a westward direction towards the coast and in a southward direction into the Sound, the Belt Sea and the Western Baltic the ray figure drops to about 50.5, and the standard deviation again falls to about 2.0—2.2, the same low figure as in the North Sea. Accordingly, the stocks spawning here are no mixed stocks: they consist of plaice of the Belt Sea form. Further it is a conspicuous fact that in the whole of this area, which extends from Hals to Femarn, there is no change in the ray figure of the spawning fish corresponding to the change that takes place within the far shorter distance from N. of the Skaw to Hals. This is the more surprising because a much greater fall of the salinity is observed in the former than in the latter area, as will appear from the following salinity figures from 10 m.s depth on Feb. 1st, stated by I. P. Jacobsen, 1908.

	Salinity in per mille 10 m., Feb. 1st.	No. of anal fin rays in spawning fish
N. of the Skaw	33	53.17
The Aalborg B.	27	50.45
N. of Femarn.....	16	50.57

So it is apparently not—at any rate not chiefly—the salinity that determines the ray figure of the plaice. As already stated by Johs. Schmidt (1918—20) the importance of the salinity as a race-forming character has often been overestimated.

If we look at the ray figure of the spawning fish of the Belt Sea, we notice that the figure for the southern part of the Lesser Belt, 51.02 ± 0.15, is rather high as compared to the figures round Langeland and in the Great Belt, 50.39 ± 0.13 and 50.54 ± 0.09; in Smaalandshavet, too, the ray figure is apparently low. A comparison of the spawning fish of the southern part of the Lesser Belt with the spawners of the adjacent waters shows that the highest ray figure is in all cases found in the Lesser Belt[1]), the differences being as follows:

N. of Funen	0.33 ± 0.22
Round Langeland	0.63 ± 0.20
Northern Great Belt.....	0.48 ± 0.18
Western Baltic W.....	0.29 ± 0.15
Western Baltic E.....	0.45 ± 0.21

Thus the difference of ray figures ranges between 0.3 and 0.6 Although we have only two instances of the difference being 3 times as great as its mean error, it appears from the figures in general that the spawning stock of the southern part of the Lesser Belt has a somewhat higher number of anal fin rays than the stocks spawning in the other areas mentioned. The idea suggests itself to put down the difference to the fact that the spawning localities of the Lesser Belt are generally situated in somewhat deeper water than in the other areas (about 28—30 m. against 20—25 m.). So there are two possible explanations, 1. a special local form with a high ray figure spawns in the deeper basin of the Lesser Belt, and other local stocks with lower ray figures spawn in shallow water elsewhere in the Belt Sea

[1]) It should be noticed that transplanted North Sea plaice—like in all other cases—are not included in the present calculations.

(for instance round Langeland and in Smaalandshavet); or 2. at the time when the plaice begin to migrate towards the spawning localities a certain selection takes place, so that fish with high ray figures go to the deeper water while fish with lower ray figures migrate to shallower waters or to a higher degree remain on or near the nursery grounds.

It has been mentioned above that an area is found in the northern and eastern Kattegat in which the spawning fish are mixed up of North Sea plaice and Belt Sea plaice. Granting that a distinction should be made between a Belt Sea form and a Baltic form one would expect to find a similar area in which the Baltic form and the Belt Sea form are mixed. In the area S. and E. of Falster and Møen we have a spawning stock with an intermediary ray figure (about 51.1 as compared to 50.6 towards the west and 51.7—52.0 towards the east). But in this area

Fig. 10. Mean numbers of anal fin rays in 0-Gr. plaice (1928—38 year-classes) from various coastal areas (cp. Table VI a and the Table in the text for the Skagerak and the Baltic) together with the corresponding standard deviations. For comparison's sake are given the mean figures for analyses of young fish (caught for transplantation, Tables 1 and 2 page 12 and 13) from the coastal waters of the North Sea.

Table 7. Mean No. of anal fin ra

Area	N[1])	S_1	S_2	K_1	K_2	K_3	K_4	K_5	K_6	K_7	$Ør_1$	$Ør_2$	$Ør_3$
42	..	..	..	..	..	..	..	..	..	..	..	..	..
43	..	..	..	..	..	..	..	..	..	..	..	..	..
44	1	..	..	..	..	..	..	..	..	..	..	1	..
45	..	..	..	1	1	..	..	3	..	2	..	4	1
46	..	..	..	2	..	..	3	8	11	8	2	27	4
47	5	..	..	7	6	3	5	29	30	23	6	45	11
48	15	1	3	21	15	14	20	66	63	19	13	78	16
49	73	5	6	48	40	33	28	112	106	39	14	101	37
50	178	7	14	93	67	40	45	156	126	63	17	127	23
51	475	24	31	187	153	51	46	152	161	78	29	141	28
52	884	39	55	318	214	65	54	129	141	57	15	148	25
53	1389	59	60	459	300	61	28	86	103	71	18	108	24
54	1583	53	71	541	343	81	22	62	59	67	21	85	27
55	1381	44	72	505	313	67	17	35	44	43	16	41	8
56	917	30	46	399	195	30	4	12	21	24	7	18	7
57	497	25	27	207	113	24	3	4	7	21	2	3	2
58	249	11	10	98	42	7	1	..	4	8	..	12	3
59	87	..	3	39	18	4	..	..	2	2	..	2	1
60	13	2	2	11	5	2	..	..	..	2	..	..	..
61	5	..	..	6	1	..	..	..	..	..	..	..	..
62	1	..	..	..	..	1	..	..	..	..	..	..	..
63	1	..	..	..	..	..	..	..	..	..	..	..	..
Total	7754	300	400	2942	1826	483	276	854	878	527	150	941	217
M.	54.06	53.89	53.86	54.05	53.75	52.91	51.34	50.95	51.22	52.07	51.69	51.09	51.22
$m \pm$	0.02	0.12	0.11	0.04	0.05	0.12	0.13	0.07	0.08	0.12	0.21	0.09	0.18
σ	2.01	2.11	2.14	2.23	2.20	2.54	2.22	2.17	2.32	2.79	2.59	2.58	2.69

the standard deviations are not so high as in the Kattegat, the figures being only 1.9—2.2. In fact we cannot expect to find a very high standard deviation in stocks that are mixed up of plaice with ray figures of 50.6 and 51.7. In an equal mixture for instance of the analyses from the eastern area of the Western Baltic (248 ind., M. 50.57) and the analyses from SW. of Bornholm (123 ind., M. 51.69) we get a mean number of 51.10 rays and a standard deviation of 2.33, which is not much higher than in the analyses of spawning fish from the Hjelms B.: 51.16, $\sigma = 2.21$. So it is very possible that the stock spawning in the areas S. and E. of Møen and Falster is composed of Belt Sea and Baltic plaice.

The spawning stock of the Baltic Proper round Bornholm consists of plaice with ray figures between 51.1 and 52.1. The standard deviation is 2.2—2.3; in one analysis, though a sparse one (44 ind.), from Christiansø even 2.8. On the whole the standard deviation is not higher in this area than farther westwards and but a trifle higher than in the Belt Sea and the North Sea. R. Kändler (1935) says, "Hier (Baltic area: the Kattegat, the Belt Sea, the Baltic) lassen die Standardabweichungen eine mehr oder weniger kontinuierliche Zunahme gegen das Innere der Ostsee erkennen ... Die geringste Steigerung zeigt die Standardabweichung bei der Analflossenstrahlenzahl (von 2,09 auf 2,3)". If the abovementioned material from the Skagerak and the Kattegat is included, it is hardly possible to establish any rise of the standard deviation from the North Sea through the inner Danish waters into the Baltic: in the North Sea and the western Skagerak $\sigma = 2.19$ and 2.17, in the Baltic E. of Bornholm $\sigma = 2.20$. A continuous rise is totally out of the question because the standard deviations are much higher in the greater part of the Kattegat than in the North Sea and the Baltic.

It was said above that the varying mean numbers of rays and standard deviations observed in stocks of spawning fish from the North Sea to the Baltic may be accounted for by the presence of 3 forms of plaice (an Atlantic, a Belt Sea and a Baltic form); in the following we will examine whether the avail-

[1]) transplanted young plaice.

he 0-Gr. in various coastal areas 1928—38.

B_3	B_4	B_5	B_6	B_7	B_8	B_9	$V\text{Ø}_1$	$V\text{Ø}_2$	Ø_1	Ø_2	Bo_1	Bo_2	Oder Bank
..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	1	..	..	..	..	2	..
1	2	1	1	2	..	6	2	..	..	..	3	3	1
4	11	4	2	5	6	17	7	3	1	2	6	13	3
14	33	33	12	14	14	58	21	7	6	9	13	17	5
27	53	62	22	20	26	94	40	5	10	12	18	23	11
49	106	111	37	24	40	111	65	6	9	18	39	46	15
69	156	157	72	34	48	167	78	7	11	19	29	61	22
84	197	245	80	31	64	208	91	7	16	16	47	56	32
131	283	254	121	40	68	214	107	5	12	17	53	71	40
72	236	198	108	28	63	203	92	6	6	15	49	55	39
64	165	130	71	27	43	116	51	6	6	8	33	46	35
28	95	73	38	11	19	58	21	3	3	3	32	34	33
22	26	33	11	4	7	23	11	1	1	3	17	24	18
7	14	16	9	..	7	6	5	1	2	1	9	3	7
1	11	3	2	..	1	3	..	..	1	1	..	4	3
1	1	..	1	..	..	1	..	..	..	..	2	3	..
1	..	1	..	..	..	..	..	..	..	..	1	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..
575	1389	1321	587	240	406	1285	592	57	84	124	351	461	264
50.74	50.87	50.68	50.95	50.03	50.47	50.28	50.25	49.67	49.88	49.79	50.80	50.56	51.45
0.09	0.06	0.06	0.09	0.16	0.12	0.06	0.09	0.37	0.28	0.22	0.15	0.13	0.16
2.28	2.23	2.17	2.16	2.42	2.36	2.32	2.26	2.81	2.54	2.45	2.72	2.73	2.54

able analyses of the ray figures of the young fish correspond to such a hypothesis. The subjoined table 7 gives the mean numbers of anal fin rays for the 0-Gr. of all year-classes between 1928 and 1938 in various coastal areas, together with the corresponding standard deviations. It appears from this table and from Figure 10 that the ray figure of the 0-Gr. varies in much the same way as that of the spawning fish. In the North Sea, the Skagerak and the northernmost Kattegat the ray figure is 53.9—54.1 and the standard deviation 2.0—2.2; thus the fry that stand here nearly exclusively belong to the North Sea form. In the Kattegat S. of Frederikshavn, however, we find more or less mixed stocks with ray figures between 51 and 53 with correspondingly high standard deviations (2.4—2.8). These mixed stocks prevail in the southern Kattegat. In the Belt Sea the ray figure is low and uniform all over the area (about 50.3—50.9); the standard deviation is comparatively low (2.2—2.3). Apparently, the stock of 0-Gr. fish standing here is comparatively pure; the fact that the standard deviation is somewhat higher than in the North race. Evidently, we have in the Kattegat (especially in the eastern and the southern part) a 0-Gr. stock that takes its rise in a mixing of the North Sea form and the Belt Sea form. In the Belt Sea, however, the Belt Sea form is the most prevalent, and the admixture of plaice of the North Sea form is generally of inferior importance. Only in the northern part of the Belt Sea the admixture is in some years so extensive, that it is perceived in the ray figure and the standard deviation: in 1932 the following mean numbers of rays and standard deviations were found in parts of the northern Belt Sea:

Area	1932 M. of rays		1934 M. of rays	
B_1	50.58 ± 0.33	2.4	50.84 ± 0.18	2.1
B_2	51.32 ± 0.21	2.3	50.62 ± 0.19	2.2
B_3	51.43 ± 0.21	2.4	50.80 ± 0.19	2.1

In other words both ray figures and standard deviations are higher in 1932 than in 1934. As regards the racial character of the fry the Sound is connected with the southern Kattegat; the ray Sea (2.0—2.1) seems to indicate a certain, though not very pronounced, admixture of plaice of foreign

figure is high (51.1—51.7) and so is the standard deviation (2.6—2.7). In the areas dealt with here the numerical character of the 0-Gr. goes well with the supposed presence of a North Sea form in the waters outside the Skaw and a Belt Sea form in the Belt Sea, but it is noticed that the divisional line between the two forms runs farther southwards in the case of the 0-Gr. than in the case of the spawning fish. The mixing area of the spawning fish is situated in the eastern Skagerak and in the northernmost and eastern Kattegat, while the mixing area of the 0-Gr. extends from the central Kattegat through the southern part of this water to the Sound and the northernmost part of the Belt Sea. This shifting of the mixing area in a southward direction is a consequence of the demonstrated influx of North Sea larvae into the Kattegat and the Belt Sea and the return of adult mature fish from the last-mentioned waters towards their places of origin.

We have noticed the clear distinction between the Belt Sea form and the North Sea form both in the spawning fish and the fry, but as far as the Belt Sea form and the Baltic form are concerned, the difference is not so pronounced in the case of the fry as in the spawning fish. It is true that the ray figure of the 0-Gr. is considerably higher round Bornholm and in the Oder Bank Area (51.0—52.0) than S. of Lolland-Falster and Møen (49.6—49.9). But something like the mixing area of the fry in the southern Kattegat can not be established here, and strange to say the standard deviation is great (about 2.7) close under Bornholm thought it is somewhat smaller at the Oder Bank and along the German coast (2.2—2.5). However, this obscurity is possibly due to the fact that the investigations in these waters almost exclusively deal with the few abundant year-classes that have appeared during recent years, more particularly the 1934 year-class. But still the considerable difference in numbers of vertebrae and anal fin rays that exists between the stocks of the Belt Sea and the Western Baltic on one side and the southern Baltic on the other appears distinctly from the following approximate mean values (partially from A. C. Johansen and R. Kändler):

Belt Sea +	Anal fin rays	No. of vert, Total	Percentage with compl. vertebrae
Western Baltic	49.7—50.5	42.4—42.7	about 22
Southern Baltic	51.0—52.2	42.8—43.0	— 40—50

Stocks with so great differences in numerical characters can hardly be included under the same race or form, and so it seems reasonable to class the plaice of the southern Baltic, that is to say the waters round Bornholm and off the coast of Pomerania as a special form, the Baltic form, which has developed concurrently with the Belt Sea form from individuals of the North Sea form, which immigrated into the Belt Sea and the Baltic during the Littorina period 6 or 7 thousand years ago. The questions whether more local forms be found in these waters and whether the two forms mentioned here in fact include several local forms cannot as yet be answered. R. Kändler (1935) has clearly stated that the "Baltic" race does not constitute a unity, and he says, "Die mangelnde Einheitlichkeit der "baltischen Rasse", die durch eine Zunahme der Wirbelzahl von 42.2—42.9 und der Analflossenzahl von 50—52 in dem Gebiet von der Kieler Bucht bis zum Bornholmbecken gekennzeichnet ist, forderte zu weiteren Untersuchungen auf". Continuous investigations on this problem are still necessary, not only statistical examinations of the numerical race characters, but also direct experimental investigations on the hereditary stability of the individual characters or their variation under the influence of external factors.

TABLE I—VIII

Table I. No. of anal fin rays of spawning plaice from the various areas (transplanted North S
The countings have been carried out by A. = Ahlman Andersen, F = S. W. Fog

Area	North Sea	W. Skagerak	Eastern Skagerak						Vinga—Læ
Locality	Horns Reef	Off Hirshals	1—2 naut. M. N. of the Skaw						
Counted by	J.	J.	J.	J.	F. P.	F. P.	L. P.		J.
Date	Sept. 1905	Aug.—Oct. 1902—1905	13/8 1903	Febr. 1910	15/3 1922	28/3 1928	13/2 1936	Tot.	10/10—4/11 1905
Stage of maturity	m.	m.	VI-VII	VI-VII	VII	VI-VII	VI-VII		m.
43	..	..	..	..	..	..	..	..	..
44	..	..	..	..	..	..	..	..	..
45	..	..	..	..	..	..	..	..	..
46	..	..	..	..	..	..	..	..	..
47	..	..	..	3	..	1	..	4	1
48	1	2	..	5	1	..	1	7	3
49	..	1	..	6	..	1	..	7	9
50	1	3	1	4	2	5	..	12	8
51	1	3	1	4	..	9	1	15	3
52	2	4	3	13	1	11	3	31	9
53	3	10	3	10	2	15	6	36	9
54	7	9	5	8	2	9	..	24	9
55	5	13	5	6	..	8	..	19	1
56	4	8	8	4	..	8	1	21	7
57	..	3	1	4	1	5	..	11	4
58	2	..	2	3	..	..	..	5	1
59	..	..	..	1	2	1	..	4	2
60	..	..	..	..	..	..	..	..	..
61	..	..	..	..	..	..	..	..	..
Total...	26	56	29	71	11	73	12	196	66
Mean...	*54.04*	*53.68*	54.55	52.56	..	53.29	..	*53.17*	*52.53*
Standard deviation σ	2.19	2.17	..	..	..	..	..	2.63	2.94
Mean error $m \pm$	0.43	0.28	..	..	..	..	..	0.19	0.36

ice not included); (m. means mature plaice without a more precise statement of the stage of maturity).
= A. C. Johansen, L. = P. L. Larsen, M. = Th. Mortensen, P. = Erik M. Poulsen.

The Skaw—Læsø					Aalborg B.			Kobbergrund—Store Middelgrund			
					SW. of Læsø	S. of Hals		Kobber-grund	N. of Anholt	ESE. of Læsø	
J.	F. P.	F. P.	P.		J.	J.		J.	J.	P.	
905—1909	1922, 1930	Jan. 1935	$^{11}/_{2}$ 1936	Tot.	1903 1905	Sept. Oct. 1905	Tot.	Jan. Mar. 1903	Sept. Oct. 1905	$^{22}/_{1}$ 1935	Tot.
V-VI—VII					m.	m.		m.	m.	V-VI—VII	
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
3	..	..	..	3	1	..	1	..	1	..	1
..	..	..	..	..	2	1	3	2	..	..	2
4	..	..	..	4	7	4	11	4	5	..	9
5	..	..	..	5	6	5	11	10	3	..	13
4	..	2	1	7	11	9	20	7	3	3	13
4	..	4	3	11	11	11	22	12	4	2	18
6	2	1	1	10	13	11	24	19	5	..	24
10	1	2	3	16	9	8	17	10	6	2	18
8	3	2	3	16	10	9	19	7	2	1	10
1	..	2	1	4	3	1	4	8	3	1	12
2	..	..	..	2	2	1	3	1	6	..	7
2	2	..	1	5	..	..	..	1	2	..	3
..	..	1	..	1	1	..	1	1	1	..	2
..	1	..	..	1	..	..	..	..	2	..	2
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
49	9	14	13	85	76	60	136	82	43	9	134
50.72	..	..	..	*51.38*	50.43	50.47	*50.45*	50.77	51.65	..	*51.06*
..	..	..	..	2.66	..	..	2.20	..	..	..	2.65
..	..	..	..	0.29	..	..	0.19	..	..	..	0.23

Table

Area	E. of Djursland			The Sound							
Locality				E. of Snekkersten	At Svinbådan	Off Skovshoved			N. of Hven	N. of Hven	
Counted by	J.	F.			J.	F. P.	F. P.	F. P.	P.	F.	
Date	Sept.—Nov. 1905	Febr. 1939	Tot.	Mar.-Apr. 1897, 1903	$^{10}/_{10}$ 1905	$^{1-4}/_{10}$ 1921	$^{13-14}/_{12}$ 1921	$^{9-18}/_{3}$ 1922	Feb.1930 Mar.1932	Febr. 1939	Tot.
Stage of maturity	m.	V-VI—VII		m.	m.	m.	m.	VI-VII	V-VI—VII		
43	..	..	..	..	..	..	..	..	..	..	..
44	..	..	..	..	..	..	..	..	..	..	..
45	..	..	..	..	..	..	..	..	..	..	..
46	1	..	1	1	..	2	..	..	..	..	3
47	7	..	7	1	7	3	3	3	2	..	19
48	16	4	20	2	9	10	2	1	4	4	32
49	29	3	32	2	9	10	3	6	8	3	41
50	25	2	27	3	9	15	5	5	14	2	53
51	25	8	33	3	13	12	4	16	11	8	67
52	13	6	19	5	13	15	13	9	9	6	70
53	9	1	10	4	10	1	2	4	4	1	26
54	5	..	5	5	3	5	2	4	2	..	21
55	2	..	2	1	2	1	..	2	..	..	6
56	1	..	1	..	1	..	..	3	..	..	4
57	..	..	..	..	2	..	..	..	..	..	2
58	..	..	..	..	..	..	..	..	..	..	..
59	..	..	..	..	..	..	..	..	..	..	..
60	..	..	..	..	..	..	..	..	..	..	..
61	..	..	..	..	..	..	..	..	..	..	..
Total...	133	24	157	27	78	74	34	53	54	24	344
Mean...	50.21	..	*50.25*	51.37	50.81	50.31	50.82	51.38	50.50	..	*50.76*
Standard deviation σ	..	..	1.87	..	..	..	..	..	..	..	2.09
Mean error $m \pm$	..	..	0.15	..	..	..	..	..	..	..	0.11

ntinued).

Northernmost part of the Belt Sea							No. of Fyen S. of Samsø					
Aarhus B.—Sejrø B. W. of Samsø												
F.	F.	F.	F.	F.	F.		F.	F.	F.	F.	L.	
$^{6}/_{2}$ 1932	$^{3}/_{3}$ 1933	Jan.-Febr. 1936	Nov. 1936-Febr. 1937	Dec. 1937-Febr. 1938	Dec. 1938-Febr. 1939	Tot.	Febr. 1932	$^{1}/_{2}$ 1933	Febr. 1934	Jan., Mar. 1935	Nov. 1937-Mar. 1938	Tot.
VI-VII	VI-VII			V-VI—VII					V-VI—VII			
..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	1	..	..	..	1	..	..	1	..	..	1
1	1	..	..	1	2	5	3	..	1	..	1	5
2	2	3	2	2	1	12	4	..	4	..	3	11
5	4	3	1	1	2	16	7	2	5	1	10	25
3	8	10	1	3	..	25	11	5	15	2	13	46
3	7	4	2	2	1	19	9	4	10	2	25	50
4	4	3	..	3	1	15	5	2	4	2	8	21
3	4	3	1	9	2	22	..	..	5	2	6	13
1	..	..	1	2	..	4	3	..	2	2	3	10
2	1	1	2	..	1	7	1	1	1	..	..	3
..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	1	..	..	..	1	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	1	..	..	1
..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..
24	31	29	10	23	10	127	43	14	49	11	69	186
50.92	50.68	50.62	..	51.52	..	*50.90*	50.28	50.79	50.69	51.73	50.75	*50.69*
..	..	..	..	..	..	2.15	..	..	..	..	..	1.78
..	..	..	..	..	..	0.19	..	..	..	..	..	0.13

Table

Area	Northern Great Belt										
Locality	Off Kerteminde		Dalby B.	At Romsø							
Counted by	J.	J.	P.	P.	F.	F.	F.	F.	F.	F. L.	
Date	2/3 1903	11/11 1905	7/2 1924	29/3 1928	6/3 1932	Dec.1934 -Mar. 1935	Jan. Febr. 1936	Nov.1936 -Febr. 1937	Mar. Apr. 1938	Dec.1938 -Febr. 1939	To
Stage of maturity	VI-VII	m.					V-VI — VII				
43	..	..	..	..	..	..	..	..	..	..	..
44	..	..	..	..	..	..	..	..	..	..	..
45	1	1	..	1	..	..	..	..	2	..	5
46	2	..	..	2	..	..	2	..	2	..	8
47	8	1	5	4	..	..	1	1	15	3	38
48	11	1	10	6	..	1	5	..	15	2	51
49	4	3	14	16	2	2	4	..	24	2	71
40	11	3	22	21	3	3	11	1	20	5	100
51	13	1	20	25	2	5	6	2	18	5	97
52	12	1	10	30	2	6	6	1	17	2	87
53	5	2	4	23	4	1	6	2	14	4	65
54	2	..	3	11	..	1	2	..	4	..	23
55	1	1	1	10	..	1	..	..	2	..	16
56	..	..	..	2	..	..	..	..	..	..	2
57	..	..	..	..	..	..	..	..	..	..	..
58	..	..	..	..	..	..	..	..	..	..	..
59	..	..	..	..	..	..	..	..	..	..	..
60	..	..	..	..	..	..	..	..	..	..	..
61	..	..	..	..	..	..	..	..	..	..	..
Total...	70	14	89	151	13	20	43	7	133	23	563
Mean...	50.03	50.07	50.22	51.37	51.23	51.25	50.44	..	50.02	50.26	50.4
Standard deviation σ	..	..	..	..	..	..	..	..	..	..	2.1
Mean error $m \pm$	..	..	..	..	..	..	..	..	..	..	0.0

ontinued).

S. Great Belt—The Langelands Belt									Smaa-lands-havet	The Southern Lesser Belt							
unde-borg	Trane-kær																
J.	J.	F.	F.	F.	F.	F.	F.		F.	F.	F. L.	F.	P.	F.	F.	F.	
$^{2}/_{3}$ 1903	$^{6-10}/_{4}$ 1909	Nov. 1929 -Febr. 1930	Nov. 1933 -Febr. 1934	Jan. Febr. 1936	Dec. 1936 -Febr. 1937	Jan. 1938	Dec. 1938 -Jan. 1939	Tot.	$^{21}/_{2}$ 1932	Nov. 1931 Mar. 1932	Jan. Mar. 1933	Dec. 1934 Mar. 1935	Jan. Febr. 1936	Dec. 1936 Jan. 1937	Dec. 1937 Jan. 1938	Dec. 1938 Jan. 1939	Tot.
m.	m.	V-VI—VII							V-VI—VII	V-VI—VII							
..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..
1	1	1	..	1	..	..	..	4	1	..	..	1	1	..	..	..	2
2	4	2	..	4	1	3	..	16	..	1	1	4	..	1	1	..	8
5	10	6	2	5	..	2	..	30	2	2	2	2	1	..	1	2	10
8	9	6	1	4	1	9	..	38	..	3	1	7	4	1	2	3	21
5	12	11	1	4	3	9	..	45	2	4	3	11	5	3	6	7	39
8	10	7	3	12	3	9	1	53	5	4	1	12	5	3	5	3	33
7	3	7	4	11	2	2	..	36	1	6	..	12	..	3	4	5	30
2	1	2	2	5	1	9	..	22	1	5	1	5	..	1	5	3	20
..	1	2	1	2	1	2	..	9	1	..	..	6	3	1	3	..	13
2	1	..	..	2	..	..	..	5	1	1	1	4	1	..	1	..	8
..	..	..	1	..	..	1	..	2	..	1	1	..	..	..	..	..	2
..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	1
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
40	52	44	15	50	12	46	1	260	16	28	11	64	20	13	28	23	187
0.25	49.67	50.16	51.47	50.74	..	50.70	..	*50.39*	*49.94*	51.39	..	51.06	50.60	..	51.36	50.65	*51.02*
..	..	..	..	..	..	..	..	2.02	..	..	..	..	..	..	..	..	2.11
..	..	..	..	..	..	..	..	0.13	..	..	..	..	..	..	..	..	0.15

Table

Area	The Western Baltic. W. part										
Locality	Between Als and Langeland										
Counted by		F. P.	F. P.	F. P.	P.	F.	F.	F.	F.	F.	
Date	Sept. Nov. 1902 1905	22/3 1922	3/3 1923	19/2 1927	Mar. Apr. 1928	Nov. 1931 Mar. 1932	Jan. Mar. 1933	Jan. Feb. 1936	Jan. 1938	Jan. Febr. 1939	Tot.
Stage of maturity	m.	VI-VII	VI-VII				V-VI—VII				
43	..	..	..	..	..	..	..	..	..	..	..
44	..	..	..	..	1	..	..	..	..	..	1
45	1	2	..	..	..	..	1	..	2	..	6
46	1	4	..	1	4	1	..	2	2	1	16
47	5	9	..	1	5	2	2	1	1	..	26
48	12	9	1	3	24	..	5	3	4	3	64
49	14	22	3	10	18	2	1	9	6	6	91
50	21	29	2	13	25	6	7	6	9	6	124
51	19	26	3	16	32	9	2	6	8	9	130
52	18	19	2	12	30	1	7	3	7	4	103
53	11	15	1	18	22	5	3	5	6	3	89
54	9	3	..	6	16	2	..	1	1	3	41
55	3	2	..	1	12	1	..	..	1	1	21
56	..	..	..	1	1	..	..	1	..	3	6
57	..	..	..	1	1	..	..	..	..	..	2
58	..	..	..	..	..	..	..	..	..	..	..
59	..	..	..	..	..	..	..	..	..	..	..
60	..	..	..	..	..	..	..	..	..	..	..
61	..	..	..	..	..	..	..	..	..	..	..
Total...	114	140	12	83	191	29	28	37	47	39	720
Mean...	50.68	50.27	50.42	51.36	51.00	50.93	50.11	50.30	50.30	51.15	*50.73*
Standard deviation σ	..	..	..	..	..	..	..	..	..	..	2.20
Mean error $m \pm$	..	..	..	..	..	..	..	..	..	..	0.08

ontinued).

The Western Baltic, E. part			Faxe Bay	E. of Møen and Falster				SW. of Bornholm	E. of Bornholm			NE. of Bornholm
S. of Rødby	E. of Gulstav								c. 10 naut. M. E. and S. of Nexø			At Christiansø
P.	F.		M.	M.	J.	P.		A. P.	A. P.	P.		P.
24/4 1922	22/3 1927	Tot.	Apr.-May 1895-97	4/4 1895	Febr. Mar. 1903	10-11/5 1928	Tot.	Aug. 1928	25/8 1928	21/1 1931	Tot.	24/6 1935
V-VI—VII			VI-VII	VI-VII	VI-VII	VI-VII		IV-VIII	IV-VIII	VI		V-VIII
..	..	..	..	..	..	..	..	..	..	1	1	..
..	..	..	..	1	..	..	1	..	..	..	..	..
..	..	..	3	..	..	..	..	..	..	..	..	..
4	1	5	1	..	2	2	4	..	..	1	1	1
12	8	20	4	..	4	8	12	3	1	5	6	..
16	7	23	10	2	17	6	25	6	1	6	7	3
16	11	27	21	9	17	14	40	11	11	13	24	3
37	11	48	24	3	29	29	61	22	12	18	30	7
26	18	44	20	7	28	21	56	11	18	22	40	6
29	16	45	18	6	37	27	70	22	5	21	26	4
11	9	20	10	5	18	25	48	23	11	12	23	7
3	4	7	8	1	14	12	27	15	6	4	10	5
3	2	5	4	1	4	7	12	8	2	2	4	4
2	..	2	1	..	2	4	6	1	1	3	4	2
..	1	1	1	..	..	3	3	..	..	1	1	..
..	..	..	..	1	..	..	1	..	..	..	..	..
1	..	1	..	..	..	..	..	..	..	..	..	1
..	..	..	..	..	..	..	..	..	1	..	1	1
..	..	..	..	..	..	..	..	1	..	..	..	..
160	88	248	125	36	172	158	366	123	69	109	178	44
50.41	50.65	*50.49*	*50.63*	50.89	51.01	51.39	*51.16*	*51.70*	51.38	50.92	*51.10*	*52.11*
..	..	2.18	2.25	..	..	..	2.21	2.23	..	..	2.20	2.83
..	..	0.14	0.20	..	..	..	0.12	0.20	..	..	0.16	0.43

Table II. Number of anal fin rays in young plaice caught in the Horns Reef Are

Year-class	1927	1928					1929					1930					1931				
Year fished	1933—36	1933	1934	1935	1936	Tot.	1933	1934	1935	1936	Tot.	1933	1934	1935	1936	Tot.	1933	1934	1935	1936	Tot.
47	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1
48	..	1	..	..	1	2	..	..	..	..	..	..	..	1	..	1	..	..	..	1	1
49	..	2	1	..	1	4	..	..	2	..	2	..	3	2	..	5	..	..	2	2	4
50	..	5	6	1	3	15	..	..	3	1	4	..	2	6	..	8	..	1	2	4	7
51	3	12	19	4	2	37	2	4	3	5	14	1	6	5	2	14	..	3	12	11	26
52	2	24	28	6	2	60	2	11	8	8	29	..	6	9	3	18	..	2	17	15	34
53	1	23	26	4	5	58	6	12	12	8	38	1	15	15	11	42	1	1	14	34	50
54	2	25	44	4	8	81	4	19	18	2	43	..	14	18	2	34	..	2	12	30	44
55	..	17	40	3	2	62	6	14	9	7	36	1	17	11	9	38	..	7	12	21	40
56	..	19	19	1	2	41	2	11	8	3	24	..	8	12	7	27	..	2	13	14	29
57	..	5	13	..	1	19	2	3	5	..	10	..	7	9	3	19	..	..	8	8	16
58	..	8	13	1	1	23	..	4	2	..	6	..	..	3	1	4	..	..	4	..	4
59	..	1	..	1	..	2	1	..	1	..	2	..	1	1	..	2	..	1	1	..	2
60	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1	..	..	..	..	..
61	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1	..	..	..	..	..
63	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total	*8*	142	209	25	28	*404*	25	78	71	34	*208*	3	80	93	38	*214*	1	19	97	141	*258*
Mean	..	53.75	54.00	53.28	53.11	*53.81*	54.20	54.19	53.92	53.12	*53.92*	..	53.96	53.99	54.34	*54.03*	..	53.89	53.80	53.55	*53.67*
$m \pm$	..	..	..	..	..	0.11	..	..	..	..	0.13	..	..	..	..	0.15	..	..	..	..	0.12
σ	..	..	..	..	..	2.14	..	..	..	..	1.91	..	..	..	..	2.22	..	..	..	..	2.07

Table III. Number of anal fin rays in young plaice caught in the costal waters o

Year-class	1928	1929			1930			1931			1932			
Year fished	1936	1935	1936	Tot.	1935	1936	Tot.	1935	1936	Tot.	1935	1936	1937	Tot.
44	..	..	..	..	..	..	..	..	..	..	..	..	..	..
45	..	..	..	..	..	..	..	..	..	..	..	..	..	..
46	..	..	..	..	..	..	..	..	..	..	..	..	..	..
47	..	..	..	..	..	..	..	..	..	..	..	..	..	..
48	..	..	..	..	..	..	..	2	..	2	..	..	..	..
49	..	..	..	..	..	..	..	1	1	2	1	..	..	1
50	..	..	..	..	1	..	1	6	..	6	1	1	..	2
51	..	1	..	1	1	..	1	6	..	6	6	3	..	9
52	..	..	..	..	..	..	..	13	1	14	20	6	1	27
53	..	..	..	..	1	..	1	11	2	13	35	15	..	50
54	1	..	..	..	1	2	3	13	2	15	51	12	..	63
55	..	..	..	..	2	..	2	11	1	12	49	20	..	69
56	..	..	1	1	1	..	1	8	3	11	42	8	..	50
57	..	1	..	1	1	..	1	3	..	3	23	8	..	31
58	..	..	..	..	1	..	1	1	1	2	11	4	..	15
59	..	..	..	..	..	1	1	1	..	1	7	1	..	8
60	..	..	..	..	..	..	..	..	..	..	1	1	..	2
61	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total	*1*	2	1	*3*	9	3	*12*	76	11	*87*	247	79	1	*327*
Mean	..	..	..	..	..	..	..	53.33	54.18	*53.44*	54.75	54.59	..	*54.70*
$m \pm$	..	..	..	..	..	..	..	..	..	0.24	..	..	..	0.11
σ	..	..	..	..	..	..	..	..	..	2.29	..	..	..	1.91

April—Maj 1933—38 for transplantation to the Belt Sea (counted by the author).

1932					1933					1934				1935			1936	All year-classes
1934	1935	1936	1937	Tot.	1935	1936	1937	1938	Tot.	1936	1937	1938	Tot.	1937	1938	Tot.	1938	1933—38
..	..	..	..	..	..	3	..	..	3	..	..	..	..	..	..	..	..	4
..	..	..	..	..	..	3	..	..	3	1	..	..	1	..	..	..	..	8
..	1	..	..	1	..	18	2	1	21	1	3	..	4	..	7	7	..	48
..	..	5	..	5	1	22	8	..	31	4	12	3	19	1	14	15	2	106
..	8	12	..	20	..	79	12	..	91	2	31	2	35	2	42	44	5	289
..	11	27	..	38	1	172	12	..	185	14	53	8	75	9	70	79	6	526
1	27	47	..	75	2	244	20	..	266	25	106	14	145	12	91	103	8	786
..	28	77	2	107	2	248	31	2	283	26	128	20	174	10	138	148	19	935
3	26	103	1	133	..	181	20	..	201	21	117	11	149	11	109	120	5	784
..	21	68	1	90	2	113	15	..	130	9	60	9	78	10	85	95	4	518
1	13	41	1	56	..	64	7	..	71	2	46	7	55	5	38	43	1	290
..	5	27	..	32	..	32	5	..	37	4	21	1	26	3	18	21	3	156
..	5	10	..	15	..	2	3	..	5	1	10	..	11	..	6	6	..	45
..	..	3	..	3	..	..	..	..	..	1	..	..	1	..	..	..	..	5
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	2	..	2
..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
..	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1
5	145	421	5	*576*	8	1 181	135	3	*1 327*	111	587	75	*773*	63	620	*683*	*53*	*4 504*
..	54.51	54.92	..	*54.82*	..	53.74	53.88	..	*53.75*	53.87	54.24	54.08	*54.18*	54.29	54.08	*54.12*	*53.72*	*54.03*
..	..	..	..	0.08	..	..	..	..	0.05	..	..	..	0.06	..	..	0.07	..	0.03
..	..	..	..	1.95	..	..	..	..	1.97	..	..	..	1.92	..	..	1.98	..	2.02

e North Sea off Thyborøn in April—May 1935—38 for transplantation (counted by S. W. Fogh).

1933					1934				1935			1936	All year-classes
1935	1936	1937	1938	Tot.	1936	1937	1938	Tot.	1937	1938	Tot.	1938	1935—38
..	..	..	..	..	..	..	..	..	..	1	1	..	1
..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..	1	1
1	..	1	..	2	..	1	..	1	1	..	1	1	7
2	3	3	..	8	..	6	..	6	2	3	5	3	25
6	8	2	..	16	1	11	1	13	9	6	15	19	72
10	22	9	..	41	6	29	2	37	29	28	57	34	186
21	40	12	..	73	5	63	1	69	51	59	110	65	358
29	83	19	..	131	17	107	2	126	91	98	189	93	603
25	92	25	..	142	10	122	6	138	85	93	178	108	648
33	75	14	1	123	11	109	3	123	67	104	171	97	597
19	49	7	..	75	3	79	3	85	55	65	120	56	399
8	28	8	..	44	4	48	3	55	16	33	49	23	207
6	11	1	..	18	1	16	1	18	9	19	28	11	93
..	4	1	..	5	..	9	..	9	8	6	14	4	42
1	..	..	..	1	..	2	..	2	3	..	3	..	8
..	..	..	..	..	1	..	..	1	..	2	2	..	3
161	415	102	1	*679*	59	602	22	*683*	426	517	*943*	*515*	*3 250*
53.90	54.11	53.63	..	*53.99*	53.85	54.22	..	*54.19*	53.97	54.20	*54.10*	*53.83*	*54.10*
..	..	..	..	0.07	..	..	..	0.07	..	..	0.06	0.09	0.03
..	..	..	..	1.95	..	..	..	1.99	..	..	1.99	1.93	1.99

Table IV. Number of anal fin rays in young plaice caught in the Nissum Broad in April—May in the years 1935—38 for transplantation (counted by S. W. Fogh).

Year-class.	1931			1932			1933				1934			1935			1936			All year-cl.
Year fished	1935	1936	Tot.	1935	1936	Tot.	1935	1936	1937	Tot.	1936	1937	Tot.	1937	1938	Tot.	1937	1938	Tot.	1935—38
47	..	..	..	..	..	..	..	1	..	1	..	..	..	..	..	..	..	..	..	1
48	..	..	..	..	..	..	1	2	..	3	..	..	..	..	..	..	..	1	1	4
49	..	1	1	..	1	1	4	1	..	5	..	1	1	..	1	1	..	4	4	13
50	..	..	..	2	1	3	10	8	..	18	6	3	9	5	3	8	..	7	7	45
51	..	..	..	6	2	8	18	20	..	38	8	8	16	20	2	22	..	18	18	102
52	..	..	..	5	1	6	45	49	..	94	16	8	24	44	11	55	..	19	19	198
53	3	1	4	15	4	19	53	69	1	123	18	15	33	49	18	67	..	37	37	283
54	..	..	..	16	12	28	50	78	1	129	32	15	47	55	23	78	1	33	34	316
55	1	1	2	18	13	31	42	45	..	87	30	18	48	47	20	67	2	37	39	274
56	..	1	1	12	10	22	28	28	..	56	16	13	29	41	10	51	..	19	19	178
57	3	..	3	4	9	13	12	11	..	23	8	9	17	13	6	19	..	10	10	85
58	..	..	..	6	4	10	6	5	1	12	2	7	9	10	2	12	..	2	2	45
59	..	..	..	1	1	2	..	3	..	3	..	2	2	2	..	2	..	1	1	10
60	..	..	..	1	..	1	..	..	..	..	..	..	..	2	..	2	..	..	..	3
61	..	..	..	..	..	..	..	1	..	1	..	1	1	..	..	..	..	..	..	2
Total...	7	4	*11*	86	58	*144*	269	321	3	*593*	136	100	*236*	288	96	*384*	3	188	*191*	*1 559*
Mean...	..	..	*54.36*	54.44	55.04	*54.68*	53.61	53.67	..	*53.65*	53.97	54.44	*54.17*	54.04	54.03	*54.04*	..	53.66	*53.67*	*53.93*
$m \pm$	..	..	..	..	..	0.17	..	..	..	0.08	..	..	0.13	..	..	0.10	..	..	0.14	0.05
σ	..	..	..	..	..	2.05	..	..	..	1.89	..	..	2.05	..	..	1.90	..	..	2.00	1.98

Table V. Number of anal fin rays in young plaice from the Skagerak (off the coast Hanstholm—the Skaw), J. from the Jammer Bay. T. from the Tannis Bay.

Year-class	1928			1929			1932				1933				
Locality	J.	T.		J.	T.		T.	T.	T.		T.	T.	T.	T.	
Date	$^{24}/_{9}$ 1930	$^{23}/_{9}$ 1930		$^{24}/_{9}$ 1930	$^{23}/_{9}$ 1930		Aug. 1935	Aug. 1935	$^{1}/_{7}$ 1936		July 1934	Aug. 1935	Aug. 1935	$^{1}/_{7}$ 1936	
Age-Gr	II	II	Tot.	I	I	Tot.	III	III	IV	Tot.	I	II	II	III	Tot.
Counted by	A. P.	A. P.		A. P.	A. P.		P.	F.	F.		F.	P.	F.	F.	
47	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..
48	..	1	1	..	..	..	..	..	..	..	..	..	..	1	1
49	3	3	6	..	1	1	..	..	..	..	..	1	1	..	2
50	6	3	9	..	1	1	..	..	..	..	1	..	3	..	4
51	9	7	16	4	2	6	..	..	..	..	2	3	15	1	21
52	14	15	29	2	4	6	1	3	..	4	2	1	14	7	24
53	34	21	55	4	2	6	..	1	2	3	4	2	24	6	36
54	27	29	56	1	6	7	..	2	2	4	3	4	28	3	38
55	23	20	43	3	4	7	1	4	1	6	..	6	24	3	33
56	8	15	23	2	..	2	..	2	1	3	1	3	20	2	26
57	11	5	16	..	1	1	..	1	..	1	..	1	8	2	11
58	7	6	13	1	1	2	..	..	1	1	..	..	5	..	5
59	1	1	2	..	..	..	..	..	1	1	1	..	2	..	3
60	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
61	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total...	144	126	*270*	17	22	*39*	2	13	8	*23*	14	21	144	25	*204*
Mean...	53.79	53.91	*53.85*	53.47	53.36	*53.41*	..	54.31	..	*54.57*	53.21	53.86	54.03	53.36	*53.87*
$m \pm$	..	..	0.13	..	..	..	..	..	..	..	..	..	..	..	0.14
σ	..	..	2.13	..	..	..	..	..	..	..	..	..	..	..	2.04

Table V (continued).

Year-class	1934							1935										
Locality	T.	T.	T.	J.	T.	T.		T.	T.	T.	J.	T.	T.	T.	T.	J.	T.	
Date	July 1934	Aug. 1935	July 1936	July 1936	Oct. 1937	Oct. 1937		July 1935	Aug. 1935	July 1936	July 1936	July 1936	7-8/10 1937	11-13/10 1937	Aug. 1937	20/10 1938	25/10 1938	
Age-Gr.	0	I	II	II	III	III	Tot.	0	0	I	I	I	II	II	II	III	III	Tot.
Counted by	A.	P.	P.	F.	F.	F.		A.	P.	P.	A.	A.	F.	F. P.	P.	F.	F.	
47	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
48	..	..	..	..	..	..	..	..	..	..	..	..	..	1	1	..	..	2
49	1	1	..	..	..	..	2	..	..	..	1	1	1	2	2	1	..	8
50	2	7	1	..	1	1	12	1	1	5	1	..	9	5	..	2	..	24
51	5	21	5	..	5	1	37	1	2	14	4	3	19	6	2	6	4	61
52	10	37	12	..	9	4	72	3	4	19	7	2	30	28	6	11	7	117
53	13	73	18	1	14	2	121	5	6	35	16	6	68	24	10	21	9	200
54	19	79	28	2	19	1	148	6	7	42	19	6	73	39	14	22	8	236
55	20	86	25	1	11	3	146	6	10	22	11	1	56	31	10	31	10	188
56	12	61	18	1	14	3	109	8	9	18	15	4	39	14	12	25	6	150
57	10	38	10	2	4	1	65	3	3	10	5	2	26	10	3	5	3	70
58	4	19	5	..	2	1	31	2	2	1	..	1	4	3	2	3	1	19
59	..	8	1	..	1	1	11	1	1	..	..	1	5	2	..	2	..	12
60	..	1	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..
61	..	1	..	..	..	..	1	..	..	..	..	..	1	..	..	..	..	1
62	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	1
Total...	96	432	123	7	80	18	*756*	36	45	166	79	27	332	165	62	129	48	*1 089*
Mean...	54.30	54.48	54.45	..	54.16	54.22	*54.42*	54.72	54.58	53.74	54.06	54.00	54.13	53.86	54.11	54.34	54.00	*54.08*
$m \pm$	..	..	..	..	..	..	0.07	..	..	..	..	..	..	..	..	..	..	0.06
σ	..	..	..	..	..	..	1.95	..	..	..	..	..	..	..	..	..	..	1.92

Table V (continued).

Year-class	1936								1937						1938			All Year-classes
Locality	J.	T.	T.	J.	J.	T.	T.		T.	J.	T.	J.	T.		J.	T.		
Date	July 1936	July 1936	Aug. 1937	1937	20/10 1938	25/10 1938	Aug. 1938		1937	1937	Aug. 1938	Aug. 1938	1938		1938	1938		
Age-Gr.	0	0	I	I	II	II	II	Tot.	0	0	I	I	I	Tot.	0	0	Tot.	
Counted by	A.	A.	P.	A.	F.	F.	P.		A.	A.	P.	A.	A.		A.	A.		
47	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
48	..	3	1	..	..	..	..	4	..	1	..	..	..	1	..	..	..	9
49	2	1	2	1	..	..	..	6	4	3	..	2	..	9	..	..	..	34
50	4	4	5	2	1	1	2	19	6	3	..	2	1	12	..	..	..	81
51	5	15	12	3	..	4	2	41	6	19	1	6	..	32	..	2	2	216
52	10	22	18	12	2	7	3	74	14	28	4	7	1	54	1	2	3	383
53	12	22	16	13	..	7	5	75	14	44	1	17	2	78	3	..	3	577
54	13	19	28	11	1	12	4	88	17	40	2	9	2	70	..	3	3	650
55	8	11	13	7	2	9	3	53	24	35	2	7	..	68	1	1	2	546
56	6	8	12	4	..	5	3	38	7	23	..	8	..	38	1	2	3	392
57	4	5	6	3	..	5	1	24	5	20	1	4	1	31	1	1	2	221
58	1	1	1	1	..	2	..	6	..	8	1	5	..	14	2	1	3	94
59	..	..	..	..	1	2	..	3	1	..	..	..	..	1	..	..	..	33
60	..	..	..	..	..	..	..	..	2	2	..	..	..	4	..	..	..	5
61	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2
62	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Total...	65	111	114	57	7	54	23	*431*	100	226	12	67	7	*412*	9	12	*21*	*3245*
Mean...	53.43	53.06	53.43	53.46	..	54.28	53.43	*53.45*	53.66	53.98	53.75	53.82	..	*53.86*	..	54.16	*54.52*	*54.01*
$m \pm$	..	..	..	..	..	..	..	0.10	..	..	..	..	..	0.11	..	..	..	0.04
σ	..	..	..	..	..	..	..	2.04	..	..	..	..	..	2.15	..	..	..	2.03

Table VI a. Mean number of anal fin rays (A) in plaice of the 0-Gr. (n = No. of spec.) caught with the Johansen Young Plaice Trawl along the coasts (see the Fig. 10) in the years 1928—38.
(Counted by Ahlm. Andersen and S. W. Fogh).

Area	K. 1		K. 2		K. 3		K. 4		K. 5		K. 6		K. 7		Ør. 1	
Year	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.
1928	53.24	249	52.78	59	53.42	33	52.57	7	..	..	..	..	..	..	48.71	7
1929	53.86	121	53.94	106	54.00	84	54.16	19	52.27	26	52.67	3	52.00	3	52.00	2
1930	53.50	241	53.54	13	51.67	15	51.11	110	50.80	80	51.00	10	50.50	8	50.87	30
1931	53.15	106	53.08	106	53.88	24	49.00	1	51.55	22	..	..	50.50	2	52.00	2
1932	54.81	977	54.77	179	54.38	26	50.47	15	50.78	9	51.83	52	52.92	62	52.06	18
1933	53.86	81	53.57	237	53.19	72	53.25	12	52.89	19	51.23	22	53.73	55	53.04	23
1934	53.87	569	54.07	247	51.51	74	50.95	60	50.77	569	51.34	288	51.14	14	52.00	1
1935	53.99	239	53.67	538	52.44	55	51.30	10	50.52	67	51.13	168	51.08	123	51.29	17
1936	53.55	119	53.59	29	53.76	13	54.00	1	53.67	3	51.40	15	51.06	35	51.31	16
1937	53.74	174	53.24	152	51.00	4	53.00	1	53.00	5	51.61	18	53.03	153	52.78	9
1938	53.58	66	53.87	160	52.57	83	51.40	40	51.80	54	51.00	302	51.13	72	50.68	25
All years[1])	54.05	2 942	53.75	1 826	52.91	483	51.34	276	50.95	854	51.22	878	52.07	527	51.69	150

Table VI a (continued).

Area	Ør. 2		Ør. 3		B. 1		B. 2		B. 3		B. 4		B. 5		B. 6	
Year	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.
1928	49.17	29	52.03	114	..	..	..	..	51.00	19	50.42	32	50.91	82	51.23	40
1929	52.47	15	54.00	1	..	..	..	..	52.00	9	53.00	1	50.78	9	53.00	1
1930	51.55	98	51.00	3	51.43	14	50.00	3	49.82	51	50.39	18	50.24	75	51.60	10
1931	48.25	8	48.50	2	..	..	..	..	49.20	5	..	..	49.62	101	..	..
1932	51.44	73	50.69	39	50.58	52	51.53	116	51.43	120	51.24	722	51.08	292	51.04	114
1933	52.36	100	51.67	3	51.64	28	49.63	19	51.15	39	51.44	9	..	..	50.78	69
1934	51.09	136	50.75	16	50.44	125	50.62	288	50.80	129	50.64	283	50.72	348	50.92	13
1935	50.53	402	49.21	14	50.00	148	50.26	313	50.26	86	50.31	86	49.98	133	50.32	53
1936	50.59	17	51.50	2	49.34	29	50.52	54	49.80	10	48.85	61	50.54	39	50.07	41
1937	52.40	5	48.00	1	51.90	41	51.10	48	50.50	22	50.50	14	51.51	37	51.50	26
1938	51.07	58	50.05	22	50.85	61	51.25	159	50.69	85	50.97	164	50.92	205	51.17	220
All years[1])	51.09	941	51.12	217	50.67	498	50.71	1 000	50.74	575	50.87	1 390	50.68	1 321	50.95	587

Table VI a (continued).

Area	B. 7		B. 8		B. 9		V. Ø. 1		V. Ø. 2		Ø. 1		Ø. 2	
Year	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.
1928	50.50	2	50.48	68	50.00	30	49.79	14	..	..	48.71	7	49.17	29
1929	..	..	49.50	8	49.34	32	45.00	1	..	..	49.50	2	49.00	1
1930	50.25	4	50.65	17	49.93	29	49.00	3	..	..	51.00	1	51.50	6
1931	46.00	1	50.30	10	48.67	3	48.67	3	..	..	49.00	1	50.00	4
1932	51.09	23	51.41	78	50.08	128	49.25	28	..	..	50.10	10	47.00	1
1933	50.00	2	51.00	28	50.12	59	49.57	42	..	..	48.50	2	49.17	12
1934	50.10	10	50.45	11	50.83	448	50.65	396	50.57	14	49.92	24	50.23	40
1935	49.26	92	49.53	66	50.53	90	48.56	18	49.41	34	49.57	30	49.62	13
1936	49.14	7	49.97	59	49.29	69	49.36	33	49.25	4	..	..	49.28	7
1937	48.00	1	50.25	44	48.75	133	48.81	31	49.20	5	48.00	1	51.00	1
1938	50.59	98	51.32	24	50.61	264	51.22	23	..	..	50.17	6	50.30	10
All years[1])	50.00	240	50.47	413	50.31	1 285	50.25	592	49.67	57	49.88	84	49.79	124

[1]) Calculated on the basis of the individual numbers.

Table VI b. Mean number of anal fin rays (A) in plaice of the 0-Gr. (n = No. of spec.) caught with the Johansen Young Plaice Trawl along the coasts (see Fig. 10) in the years 1928—38.
(Counted by Ahlm. Andersen and S. W. Fogh).

Area	K. 1		K. 2		K. 3		K. 4		K. 5		K. 6		K. 7		Ør. 1	
Year	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.
1928	..	..	54.00	17	53.67	33	51.20	5	..	..	..	..	..	..	..	..
1929	54.15	312	53.47	160	53.99	119	52.75	61	..	..	52.33	9	53.36	25	53.00	1
1930	53.74	39	52.33	3	52.60	5	53.93	13	52.40	5	..	..	..	..	..	..
1931	53.74	160	53.26	70	50.94	17	50.83	88	50.65	118	51.00	15	52.17	6	..	..
1932	53.23	61	52.59	7	52.00	2	..	..	53.00	2	..	..	53.00	1	..	..
1933	54.90	100	54.33	176	53.76	29	49.25	4	50.72	28	49.57	14	54.83	6	..	..
1934	53.92	147	53.36	33	52.24	17	53.50	2	52.83	6	51.00	1	..	..	..	..
1935	53.89	122	53.45	125	51.91	11	..	..	51.00	3	52.00	1	50.00	1	..	..
1936	53.15	48	53.53	15	50.33	12	..	..	50.56	18	51.50	20	51.33	6	54.00	1
1937	53.68	85	54.80	10	53.00	1	..	..	..	..	..	..	54.00	1	53.00	1
1938	53.73	91	53.30	89	..	..	..	..	..	..	..	..	51.00	1	..	..
All years[1])	53.92	1 165	53.63	705	52.78	246	51.75	173	50.90	180	51.05	60	53.02	47	53.33	3

Table VI b (continued).

Area	Ør. 2		Ør. 3		B. 1		B. 2		B. 3		B. 4		B. 5		B. 6	
Year	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.
1928	49.50	6	51.13	8	..	..	..	..	51.00	32	49.69	13	51.60	48	51.43	23
1929	50.77	13	51.64	96	..	..	..	..	50.64	55	50.71	7	49.92	13	50.86	7
1930	51.00	6	53.00	1	50.00	2	..	..	50.74	31	50.50	2	48.50	2	51.00	1
1931	51.04	27	49.56	9	..	..	50.67	6	50.25	4	..	..	50.11	35	..	..
1932	51.50	2	..	..	50.50	4	51.00	1	49.00	1	50.00	3	50.00	2	48.67	3
1933	51.29	24	49.50	2	51.29	14	51.63	35	51.46	59	50.93	14	50.63	19	51.11	18
1934	..	..	..	..	..	..	51.00	3	51.11	9	..	..	50.22	9	53.00	1
1935	50.00	7	50.36	14	50.63	8	49.50	2	50.92	25	49.00	3	50.78	9	..	..
1936	51.20	10	51.00	7	49.00	3	51.63	8	50.00	1	50.00	4	50.40	15	51.13	8
1937	..	..	..	..	..	..	..	..	52.00	1	46.50	2	49.70	20	52.00	1
1938	..	..	..	..	50.00	1	49.50	2	50.00	1	53.00	2	51.40	30	50.67	3
All years[1])	50.85	95	51.30	137	50.69	32	51.39	57	50.97	219	50.26	50	50.69	202	51.11	65

Table VI b (continued).

Area	B. 7		B. 8		B. 9		V. Ø. 1		V. Ø. 2		Ø. 1		Ø. 2	
Year	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.	A.	n.
1928	..	..	51.20	5	50.20	10	..	..	..	..	50.00	6	49.50	6
1929	49.50	2	48.60	5	50.14	7	..	..	..	..	50.72	25	49.29	7
1930	49.00	1	49.00	1	48.50	14	..	..	..	..	..	..	49.50	8
1931	..	..	51.80	5	48.50	2	..	..	..	..	49.67	9	51.00	4
1932	..	..	..	..	52.00	1	..	..	..	..	..	..	..	..
1933	48.00	1	51.20	5	50.43	14	..	..	..	..	..	..	..	..
1934	..	..	..	..	51.00	4	..	..	..	..	..	..	..	..
1935	..	..	50.50	2	48.75	4	50.00	2	..	..	50.28	25	51.25	8
1936	..	..	50.70	10	49.75	4	..	..	..	..	..	..	51.24	17
1937	..	..	50.00	8	52.00	2	..	..	..	..	..	..	..	..
1938	51.00	1	50.50	2	49.00	2	52.00	1	..	..	..	..	..	..
All years[1])	49.40	5	50.47	43	49.83	64	50.67	3	..	..	50.31	65	50.56	50

[1]) Calculated on the basis of the individual numbers.

Table VII. Numbers of anal fin rays of the 0-, I- and II-Groups in the Belt Sea arranged according to year-classes and areas (A.—F). The 0-Gr. material originates from the coastal investigations; the I- and II-Gr. material from the experimental fishery with the eeltog and from commercial catches.

Year-class..	1927																		
Area	A.			B.			C.			D.			E.			F.			Total
Gr.....	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	
43.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1
44.....	..	..	..	..	..	..	2	..	..	..	..	..	..	1	..	..	..	..	3
45.....	..	..	..	1	..	..	3	1	..	..	..	..	..	..	..	..	..	..	5
46.....	2	..	1	8	1	..	2	1	..	1	..	..	1	..	..	2	..	1	20
47.....	9	..	..	19	2	1	8	1	2	..	..	..	..	1	..	2	1	..	46
48.....	12	..	6	16	4	1	11	2	8	2	1	..	1	2	1	2	..	1	70
49.....	29	..	5	28	6	6	23	2	16	3	3	1	2	2	1	3	1	4	135
50.....	24	..	11	38	10	7	36	8	23	3	6	..	3	1	..	6	3	7	186
51.....	35	..	9	32	13	10	33	6	22	1	6	..	4	..	..	7	4	6	188
52.....	26	..	13	42	9	6	19	7	21	4	3	..	..	1	..	3	1	6	161
53.....	19	..	7	31	5	6	25	10	20	4	6	..	3	..	..	6	..	3	145
54.....	13	..	3	12	1	3	16	6	16	1	1	..	1	..	..	2	..	2	77
55.....	6	..	1	14	1	..	6	3	7	..	2	..	..	..	..	2	..	1	43
56.....	3	..	1	5	..	..	1	1	1	..	..	..	..	..	..	1	..	..	13
57.....	1	..	..	1	..	..	..	..	1	..	..	..	..	..	..	..	..	..	3
58.....	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1
59.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
60.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
61.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total...	179	..	57	247	52	40	185	48	137	19	28	1	16	8	2	37	10	31	1097
Mean...	50.91	..	51.02	50.85	50.60	51.03	50.77	51.60	51.45	50.74	51.39	49.00	50.94	48.38	48.50	50.73	50.20	50.97	51.06

Table VII (continued).

Year-class..	1928																		
Area.....	A.			B.			C.			D.			E.			F.			Total
Gr.	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	
43.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
44.....	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
45.....	..	..	..	..	1	..	..	..	..	2	..	..	..	..	1	1	..	..	5
46.....	..	..	..	..	..	..	..	..	..	1	..	1	..	..	2	1	1	..	6
47.....	..	..	..	2	3	..	2	2	..	5	3	..	..	..	1	1	..	..	19
48.....	..	1	..	6	4	..	9	2	..	10	2	1	..	..	5	4	1	..	45
49.....	..	..	..	10	9	3	10	8	..	11	1	..	..	1	5	5	1	..	64
50.....	..	..	..	12	16	1	20	9	..	18	1	..	..	1	7	5	1	1	92
51.....	..	1	2	12	11	1	12	11	..	16	1	1	..	..	2	6	..	..	76
52.....	..	..	..	6	7	..	11	7	..	15	1	1	..	..	6	3	1	..	58
53.....	..	1	1	6	5	1	6	6	..	9	2	..	..	..	10	3	2	..	52
54.....	..	..	..	1	5	..	6	6	..	10	1	..	..	..	2	1	..	..	32
55.....	..	..	..	1	..	..	4	..	..	1	..	..	..	..	..	..	..	..	6
56.....	..	..	..	..	1	..	1	..	..	2	..	..	..	..	..	..	..	..	4
57.....	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1
58.....	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	1
59.....	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
60.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
61.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total...	..	4	3	57	62	6	82	51	..	101	12	4	..	2	41	30	7	1	463
Mean...	..	49.00	51.67	50.56	50.56	50.17	50.91	50.96	..	50.77	49.92	49.25	..	49.50	50.51	50.00	50.14	50.00	50.62

Table VII (continued).

Year-class..	1929																		
Area	A.			B.			C.			D.			E.			F.			Total
Gr.....	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	
43.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
44.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	..	2
45.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2	..	1	3
46.....	..	..	..	..	..	..	..	..	1	1	..	..	..	..	..	1	..	3	6
47.....	..	..	6	..	2	1	2	..	1	..	..	..	..	..	..	4	..	3	19
48.....	..	..	7	..	2	3	..	1	7	1	1	..	..	..	..	3	1	4	30
49.....	..	..	11	1	5	5	..	2	16	..	1	..	..	1	..	3	1	11	57
50.....	..	1	18	..	6	12	..	..	15	4	..	..	..	..	..	3	..	14	73
51.....	..	..	15	2	7	13	3	1	17	2	1	..	..	..	..	4	..	19	84
52.....	..	..	16	3	5	15	3	..	9	..	1	..	..	..	..	8	..	13	73
53.....	..	..	12	3	2	8	..	..	9	1	..	..	..	..	..	2	..	5	42
54.....	..	..	11	..	4	5	1	..	3	..	..	..	..	..	..	..	..	5	29
55.....	..	..	5	1	..	2	..	..	2	..	..	..	..	..	..	..	..	2	12
56.....	..	..	4	..	..	1	..	..	..	..	..	..	..	..	..	..	..	2	7
57.....	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
58.....	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
59.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
60.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
61.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total...	..	1	107	10	33	65	9	4	80	9	4	..	..	1	..	32	2	82	439
Mean...	..	50.00	51.38	52.10	50.73	51.37	50.78	49.25	50.59	49.89	50.00	..	..	49.00	..	49.34	48.50	50.70	50.83

Table VII (continued).

Year-class..	1930																		
Area	A.			B.			C.			D.			E.			F.			Total
Gr.....	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	
43.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
44.....	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	..	..	..	2
45.....	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
46.....	..	..	..	1	..	1	..	1	4	..	..	1	..	..	2	3	..	..	13
47.....	..	..	4	7	..	5	7	5	2	2	..	1	..	1	3	1	..	1	39
48.....	..	..	6	13	2	8	5	10	14	1	2	3	..	3	8	5	1	6	87
49.....	1	6	8	10	5	18	14	7	23	2	..	2	2	..	10	3	2	5	118
50.....	1	7	23	14	7	19	23	16	15	2	..	3	..	1	15	6	1	4	157
51.....	1	8	22	13	4	23	18	13	28	8	..	5	1	..	13	3	1	5	166
52.....	..	8	16	3	2	21	11	9	28	9	1	9	1	1	6	3	1	..	129
53.....	..	2	11	4	3	6	5	8	14	2	1	1	..	..	5	4	..	5	71
54.....	..	1	5	1	2	4	3	2	7	..	..	1	..	2	4	..	1	4	37
55.....	..	1	5	1	..	..	2	5	2	1	..	1	..	..	2	1	..	1	22
56.....	..	..	..	1	..	..	1	1	3	..	..	..	..	..	..	..	..	..	6
57.....	..	..	2	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	3
58.....	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	1
59.....	..	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	1
60.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
61.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total...	3	33	102	69	25	105	89	79	141	27	5	27	4	8	69	29	7	31	853
Mean...	50.00	51.00	51.12	49.71	50.64	50.44	50.43	50.80	50.73	51.00	52.00	50.74	50.25	50.13	50.25	49.93	50.43	50.68	50.58

Table VII (continued).

Year-class..	1931																		
Area	A.			B.			C.			D.			E.			F.			Total
Gr.....	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	
43.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
44.....	..	..	..	..	..	..	..	1	1	..	..	1	..	..	..	..	..	..	3
45.....	..	..	..	..	..	..	..	..	..	..	2	2	..	..	1	..	..	..	5
46.....	..	..	3	..	..	1	8	2	1	..	1	2	1	1	..	1	..	..	21
47.....	..	..	4	1	1	..	13	2	5	1	2	7	..	..	1	1	..	1	39
48.....	..	2	8	1	..	1	9	3	6	..	4	11	..	1	2	..	2	3	53
49.....	..	3	9	..	..	1	14	8	7	3	6	12	..	2	5	..	1	7	78
50.....	..	..	14	2	2	5	22	9	11	2	7	13	..	3	3	..	2	6	101
51.....	..	3	20	1	..	3	16	11	17	1	3	14	..	5	2	..	2	4	102
52.....	..	3	15	..	..	2	9	7	17	1	7	14	..	4	2	..	4	2	87
53.....	..	..	7	..	..	2	9	..	10	2	4	8	..	..	2	1	..	4	49
54.....	..	..	6	..	..	..	1	2	7	..	1	3	..	..	2	..	..	3	25
55.....	..	..	2	..	..	1	..	..	4	..	..	2	..	..	2	..	..	..	11
56.....	..	..	2	..	..	..	..	..	..	..	..	1	..	..	..	..	..	1	4
57.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
58.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
59.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
60.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
61.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total...	..	11	90	5	3	16	101	45	86	10	37	90	1	16	22	3	11	31	578
Mean...	..	50.18	50.76	49.20	49.00	50.69	49.62	49.98	50.99	50.30	49.97	50.17	46.00	50.31	50.59	48.67	50.45	50.71	50.30

Table VII (continued).

Year-class..	1932																		
Area	A.			B.			C.			D.			E.			F.			Total
Gr.....	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	
43.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
44.....	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
45.....	1	1	..	4	..	..	1	..	..	..	..	..	..	..	..	1	..	..	8
46.....	2	2	1	12	..	..	7	..	1	2	..	..	2	..	..	13	..	1	43
47.....	4	..	2	24	1	..	11	..	2	7	..	..	1	4	..	9	4	5	74
48.....	6	5	3	49	..	2	29	1	4	7	1	..	..	1	2	11	3	5	129
49.....	9	8	11	84	6	4	38	2	16	22	3	..	2	6	1	11	4	5	232
50.....	14	20	15	106	5	5	44	2	33	32	4	..	2	7	..	21	12	6	328
51.....	10	21	12	176	8	8	73	2	35	39	3	..	3	7	..	25	7	9	438
52.....	28	19	19	144	6	6	55	2	33	31	5	..	7	5	1	20	7	12	400
53.....	24	11	9	128	4	3	46	1	25	32	5	..	4	5	..	8	5	7	317
54.....	9	6	5	66	4	4	23	..	13	12	1	..	1	2	..	7	5	5	163
55.....	7	6	8	23	2	4	11	..	9	2	..	..	1	..	..	2	..	3	78
56.....	1	..	1	14	..	..	5	1	1	5	..	..	..	..	..	..	1	...	29
57.....	1	1	..	9	..	..	..	..	..	1	..	..	..	..	..	..	..	..	12
58.....	..	1	..	1	..	..	..	..	1	..	..	..	..	..	..	..	..	..	3
59.....	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1
60.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
61.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62.....	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
Total...	116	101	86	842	36	36	344	11	173	192	22	..	23	37	4	128	48	58	2 257
Mean...	51.52	51.29	51.35	51.28	51.36	51.58	51.00	51.00	51.46	51.18	51.23	..	51.09	50.54	49.25	50.08	50.84	50.95	51.15

Table VII (continued).

Year-class..	1933																		
Area	A.			B.			C.			D.			E.			F.			Total
Gr.....	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	
43.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
44.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
45.....	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
46.....	1	..	..	..	..	..	..	..	2	2	..	1	..	..	..	..	1	..	7
47.....	1	1	1	2	..	..	..	..	3	5	..	..	..	..	..	7	..	..	20
48.....	3	..	..	2	..	..	1	1	8	5	..	5	..	..	..	6	1	1	33
49.....	5	1	2	7	..	..	2	2	7	16	..	5	1	..	..	12	4	4	68
50.....	2	4	3	5	1	..	4	3	16	13	..	2	..	..	..	10	6	5	74
51.....	4	1	1	8	..	..	7	4	22	22	..	8	1	..	..	9	5	8	100
52.....	2	2	1	9	..	..	8	4	13	13	..	6	..	..	..	7	2	5	72
53.....	1	..	2	6	..	..	1	4	9	8	..	1	..	..	..	4	..	2	38
54.....	..	3	2	6	..	..	2	..	3	7	..	1	..	..	..	3	..	2	29
55.....	..	..	1	1	..	..	2	..	4	5	..	..	..	..	..	1	..	1	15
56.....	..	..	..	1	..	..	1	..	1	1	..	..	..	..	..	..	..	..	4
57.....	..	..	2	..	..	..	..	2	..	..	..	..	..	..	..	..	..	..	4
58.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
59.....	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	1
60.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
61.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total...	19	12	15	48	1	..	28	20	89	97	..	29	2	..	..	59	19	28	466
Mean...	49.63	51.08	52.07	51.19	50.00	..	51.64	51.70	50.92	50.84	..	50.28	50.00	..	..	50.12	49.95	51.11	50.83

Table VII (continued).

Year-class..	1934																		
Area	A.			B.			C.			D.			E.			F.			Total
Gr.....	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	
43.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
44.....	..	..	..	1	..	..	1	..	..	..	..	..	..	..	..	2	..	..	4
45.....	2	1	..	2	..	..	1	..	..	..	..	..	..	..	..	2	..	1	9
46.....	6	1	..	8	..	..	8	4	..	1	..	..	..	..	..	4	2	4	38
47.....	13	1	10	19	1	3	9	4	..	1	4	4	1	..	..	19	4	4	97
48.....	25	5	11	35	7	3	37	7	1	2	3	7	2	..	4	32	7	6	194
49.....	40	9	20	48	4	9	63	15	6	2	1	14	2	..	1	52	9	12	307
50.....	52	10	30	71	5	9	96	15	8	3	3	20	2	..	7	79	18	20	448
51.....	53	14	30	96	7	14	77	11	11	5	3	15	..	..	11	88	14	20	469
52.....	46	12	17	51	10	6	41	17	8	6	3	17	1	..	3	82	13	18	351
53.....	25	4	16	42	5	7	23	10	6	3	2	10	1	..	4	48	8	7	221
54.....	16	2	5	24	2	3	14	7	4	1	..	3	..	..	4	24	4	4	117
55.....	5	2	4	8	..	2	5	..	1	..	..	..	..	..	..	9	1	1	38
56.....	4	1	..	3	1	..	1	..	..	..	..	2	..	..	..	4	2	..	18
57.....	1	1	1	3	..	..	..	..	..	..	..	..	..	..	..	2	..	..	8
58.....	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	1	..	..	2
59.....	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	1
60.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
61.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total...	288	63	144	412	42	57	376	90	45	24	19	92	9	..	34	448	82	97	2 322
Mean...	50.62	50.79	50.60	50.69	50.83	50.96	50.29	50.53	51.30	50.71	49.79	50.68	49.56	..	51.06	50.83	50.67	50.42	50.63

Tabel VII (continued).

Year-class..	1935																		
Area	A.			B.			C.			D.			E.			F.			Total
Gr.....	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	
43.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
44.....	..	..	..	1	..	..	..	..	..	..	..	..	2	..	..	..	..	..	3
45.....	2	..	..	1	..	2	3	..	2	5	..	1	5	..	..	..	..	..	21
46.....	25	2	2	12	..	..	10	..	2	5	1	..	9	1	..	3	1	..	73
47.....	34	1	8	7	1	5	9	1	6	6	3	5	12	5	..	7	4	4	118
48.....	55	9	8	18	5	11	13	9	9	21	9	1	9	4	3	5	9	6	204
49.....	56	18	19	17	6	19	16	10	19	16	9	8	11	4	..	14	4	10	256
50.....	75	19	32	27	13	26	28	13	24	14	12	10	8	8	2	16	7	7	341
51.....	88	24	24	38	10	32	19	11	29	23	12	9	19	7	1	16	6	19	387
52.....	58	24	19	27	7	14	19	6	18	19	10	3	7	8	..	12	7	12	270
53.....	30	12	15	14	3	14	6	4	10	5	7	6	5	6	1	8	6	7	159
54.....	25	9	10	3	1	3	5	4	5	4	1	4	3	3	..	5	2	4	91
55.....	12	4	1	6	1	..	4	2	2	1	3	2	2	2	..	3	1	..	46
56.....	1	..	1	1	2	..	1	1	..	..	..	2	..	1	1	1	..	..	12
57.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
58.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
59.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
60.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
61.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total...	461	122	139	172	49	126	133	61	126	119	67	51	92	49	8	90	47	69	1 981
Mean...	50.18	50.96	50.64	50.27	50.71	50.38	49.98	50.59	50.41	50.20	50.48	50.80	49.26	50.78	50.50	50.53	50.28	50.67	50.32

Table VII (continued).

Year-class..	1936																		
Area	A.			B.			C.			D.			E.			F.			Total
Gr.....	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	
43.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
44.....	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	..	..	..	1
45.....	..	..	..	6	..	..	1	..	..	..	..	..	..	..	..	5	..	1	13
46.....	5	..	2	12	1	1	1	1	..	9	..	3	1	..	..	6	..	..	42
47.....	9	1	5	8	1	..	4	1	4	7	1	..	1	1	..	8	..	1	52
48.....	12	1	3	5	1	..	5	1	2	9	..	3	1	..	..	9	2	5	59
49.....	7	..	8	11	..	..	4	5	5	16	3	5	1	1	..	7	..	7	80
50.....	11	1	5	6	4	..	3	3	6	15	..	6	1	..	..	13	3	6	83
51.....	13	..	15	11	2	..	6	4	5	12	3	5	1	..	..	7	2	3	89
52.....	15	..	4	8	3	1	5	4	2	15	1	4	..	..	..	7	1	7	77
53.....	6	..	5	2	..	..	4	5	4	10	1	3	1	..	..	1	1	3	46
54.....	2	..	5	2	..	..	4	5	..	5	..	..	..	..	..	5	..	..	28
55.....	..	1	1	..	..	..	1	1	2	1	..	1	..	..	..	1	..	1	10
56.....	3	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3
57.....	..	..	1	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	2
58.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
59.....	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
60.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
61.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total...	83	4	55	71	12	2	39	30	30	100	9	30	7	2	..	69	9	34	586
Mean...	50.11	50.00	50.76	48.85	49.91	49.00	50.54	51.27	50.33	50.00	50.22	50.13	49.14	48.00	..	49.29	50.33	50.18	50.02

Table VII (continued).

Year-class..	1937																		
Area	A.			B.			C.			D.			E.			F.			Total
Gr.....	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	0	I	II	
43.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	1
44.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	..	..	1
45.....	..	..	..	..	..	..	..	..	..	1	..	..	..	..	..	6	1	..	8
46.....	4	1	..	1	..	..	1	1	..	3	..	..	..	..	..	20	..	..	31
47.....	3	4	..	4	1	..	3	2	..	9	3	..	..	..	..	22	2	..	53
48.....	6	8	..	4	3	..	1	8	..	7	2	..	1	..	..	15	5	..	60
49.....	6	9	..	4	..	..	4	8	..	3	3	..	..	..	..	25	8	..	70
50.....	10	27	..	4	6	..	4	10	..	7	5	..	..	..	..	10	16	..	99
51.....	14	26	..	6	6	..	8	15	..	10	7	..	..	1	..	14	12	..	119
52.....	13	37	..	5	1	..	3	13	..	10	2	..	..	..	..	9	7	..	100
53.....	14	31	..	4	6	..	3	6	..	9	3	..	..	..	..	8	10	..	94
54.....	9	44	..	2	..	..	3	6	..	6	..	..	..	..	..	1	2	..	73
55.....	5	22	..	2	..	..	3	2	..	2	1	..	..	..	..	1	1	..	39
56.....	4	16	..	..	2	..	3	..	..	1	..	..	..	..	..	1	..	..	27
57.....	1	8	..	..	..	..	1	..	..	2	..	..	..	..	..	..	..	..	12
58.....	..	4	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4
59.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
60.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
61.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
62.....	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Total...	89	237	..	36	25	..	37	71	..	70	26	..	1	1	..	133	65	..	791
Mean...	51.49	52.70	..	50.50	51.16	..	51.51	50.83	..	50 71	50.35	..	48.00	51.00	..	48.75	50.51	..	51.06

Table VIII. Number of anal fin rays in the year-classes 1916—1938 (various age-groups) in the Western Baltic between Langeland and Als.

Year-class	1916	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	Total
43.....	..	..	..	..	..	..	1	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	2
44.....	..	..	..	..	..	..	..	..	..	1	..	..	1	..	..	1	..	..	..	1	..	..	..	4
45.....	..	1	1	..	..	..	..	1	..	..	..	2	..	1	..	1	4	1	1	3	..	1	..	17
46.....	1	..	2	2	..	..	2	3	4	1	..	1	4	..	1	1	1	2	13	3	5	2	..	48
47.....	1	1	2	1	..	2	2	7	4	2	1	3	3	2	3	4	4	6	15	9	7	7	..	86
48.....	2	2	3	2	2	..	6	23	6	8	2	14	7	..	11	7	8	6	54	11	7	6	..	187
49.....	2	2	10	9	2	1	9	25	13	10	5	12	3	3	5	4	29	12	53	20	4	7	5	245
50.....	6	6	7	5	2	8	14	37	13	10	4	22	14	16	15	5	20	15	65	22	8	4	4	322
51.....	5	5	10	6	1	7	11	41	15	17	5	15	11	13	11	8	15	16	95	16	11	2	3	337
52.....	3	5	3	2	4	3	16	44	11	14	3	15	11	7	5	11	9	9	85	15	5	4	6	290
53.....	2	3	3	4	1	4	7	29	11	3	4	19	7	9	5	2	8	8	43	14	3	2	3	194
54.....	..	1	2	..	1	1	8	16	11	2	2	6	4	2	2	2	1	3	17	3	2	..	1	87
55.....	..	..	..	2	1	1	1	11	4	3	1	3	..	..	..	..	1	1	11	2	..	..	1	43
56.....	..	..	..	..	1	..	..	2	..	..	..	2	..	..	1	1	1	1	6	..	2	..	..	17
57.....	..	..	..	..	..	1	..	3	..	..	..	1	..	..	1	..	..	..	1	..	..	..	..	7
Total..	22	26	43	33	15	28	77	242	92	71	27	115	66	53	60	47	101	80	459	119	54	35	23	1888
Mean..	50.18	50.54	49.95	50.24	51.40	51.21	50.77	51.07	50.88	50.49	50.89	50.84	50.23	50.91	50.28	50.11	49.91	50.67	50.67	50.07	49.83	48.94	51.22	50.53

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XXV. *C. G. Joh. Petersen:* The Sea Bottom and its production of Fish-Food. A survey of the work done in connection with valuation of the Danish waters from 1883—1917. With 12 Plates and 1 Chart. 82 pp. 1918.

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XXXIII. I. *A. C. Johansen:* On the Fluctuations in the Quantity of Young Fry among Plaice and certain other species of fish, and causes of the same. With 7 figures and 1 table. — II. *A. C. Johansen:* On a Spawning Place for winter spawning Herring in the northern part of the Belt Sea. With 2 figures. — III. *H. Blegvad:* On the Annual Fluctuations in the Age-composition of the stock of Plaice. With 2 figures. — IV. *R. Spärck:* Studies on the Biology of the Oyster *(Ostrea edulis)* II—IV. 65 pp. 1927.

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